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NEW SERIES, VOLUME XLVII

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A PRACTICAL JOURNAL BUILT ON MERIT

EDITORIAL

NON-OPERABLE GROUP OF CRANIOCEREBRAL INJURIES

WE are inclined, in present day methods of teaching surgery, to resort considerably to groupings and classifications of disease entities and pathologic pictures, and occasionally merely allude to the fact that in some conditions, one clinical picture "overlaps the other." A clearer understanding of the pathogenesis will undoubtedly be followed by a more accurate knowledge of the pathologic findings, and this in turn will make more easily understandable the symptomatology. With meticulous pseudoprecision, for example, we teach and learn the classifications of brain injuries, and ascribe to each entity a group of pathologic findings and the resultant symptomatology, as though each had its own classical story. In approximate order of increasing severity, we group the non-operable craniocerebral injuries as concussion, edema and congestion, and contusion and laceration.

The pathology of concussion is not definitely known. Perhaps it is a reflex of some type resulting in anoxemia. The chief symptom, however, is unconsciousness for a short period of time, followed by complete recovery.

The pathology of edema and congestion in themselves is rather difficult to evaluate, as edema and congestion are rarely present without the accompaniment of more serious brain damage. It might perhaps be briefly stated that there is here an increase in brain volume, which if sufficiently sustained, eventuates in intracortical hemorrhage. The signs and symptoms, as is well known, are unconsciousness followed by a return of consciousness, after which there is headache and dizziness, nausea, and some loss of memory. There is often increased intracranial pressure, but the cerebrospinal fluid is normal.

In contusion, there is some injury to the brain surface with torn cortical vessels. In laceration, the cortical surface is actually torn. Here the symptoms are more profound. There is a definite and prolonged period of unconsciousness, which may last for days. There is nausea and vomiting, and headache. In the more severe cases, there may be dilatation of the pupils, irregularity of respiration, and increase in pulse and temperature. Surgical shock is frequently present. The intracranial pressure is high, and the cerebrospinal fluid contains blood.

It is thus quite obvious that the consideration of the pathology of contusion and laceration includes that also occurring in edema and congestion, as well as that of concussion. The same can be said as regards symptomatology. Both contusion and laceration are associated with edema and congestion, and these in turn incor-

porate concussion. Stating it in another way, following craniocerebral injuries, edema and congestion include concussion. For example, the unconsciousness in laceration is not necessarily due to the tear in the brain cortex, as the concussion present was sufficient to cause it; the more severe pathologic findings and symptoms are due to the added damage, i.e., from the arbitrary division beyond concussion.

It is thus seen that the present classification is more of a didactic rather than either a true clinical or pathologic one. If the foregoing is kept in mind, there will be a better understanding and appreciation of some of the non-operable craniocerebral injuries, and more important, a better rationalization when thinking in terms of therapeutic measures.

RAYMOND GREEN, M.D., F.A.C.S.

ORIGINAL ARTICLES

POSTOPERATIVE WOUND DISRUPTION AND EVISCERATION

AN ANALYSIS OF THIRTY-FOUR CASES WITH A REVIEW OF THE LITERATURE

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THIS study includes thirty-four cases of postoperative eviscerations that have occurred in the Cedars of Lebanon Hospital, Los Angeles, California, together with remarks based on a review of the recent literature with the object of analyzing the mechanism of production and suggestions in the prevention and treatment.

A review of the literature is a comedy of contradictions. It is instructive because various authors have arrived at different conclusions based on their individual series of statistics. It teaches us to be cautious in drawing conclusions from any one single series.

In this study we shall discuss (1) the factors which are inherent in the patient, such as age, sex, primary disease, previous operations, preoperative condition, postoperative course; and (2) the factors in the operation and postoperative course for which the surgeon is responsible, such as anesthesia, type of incision, closure, operative procedure, infection, and drainage. Certain inherent factors ascribed to the patient which have a bearing on the incidence of evisceration may be partially diminished by the surgeon, e.g., (1) preoperative—emaciation, dehydration, anemia and shock; (2) postoperative—distention, cough, vomiting, hiccough and restlessness.

Then we shall acquaint ourselves with the materials with which we are working, viz., tissues, wound healing and catgut, later discussing the mechanism of evisceration, reviewing preventive steps in the treatment adopted by various operators and summarize our conclusions based on a review of the literature.

Incidence. An idea of the incidence will be gleaned by listing the sources from which analyses and comparisons have been made in this study. Sokolov[60] analyzed the replies which he received from 1,000 questionnaires sent out to surgeons all over Europe and concluded that the incidence varied from 2 to 3 per cent of all abdominal operations. Carl Eggers[12] (1934) showed

TABLE 1
INCIDENCE AND MORTALITY OF DISRUPTIONS AND EVISCERATIONS

Author	Laparotomies	Disruptions and Eviscerations	Per Cent	Deaths	Per Cent Mortality
Bettman and Lichtenstein	.....	32	0.43	12	38
Bowen	.....	34	....	17	50
Colp	2,750	26	0.9	8	28
Eggers	.....	20	....	6	30
Eliason and McLoughlin	9,155	25	0.27	8	32
Fallis	7,903	50	0.64	17	34
Grace	.....	46	....	15	39
Glenn and Moore	2,927	22	0.75	10	45.5
Glasser	3,234	8	0.24	6	75
Heyd	3,145	8	0.25	2	25
Hinton	621	19	3.05	3	16
Horner	9,155	3	0.29	0	0
Jenkins	.....	36	....	13	36
Koster and Kasman	.....	17	0.22	3	18
Maes, Boyce and McFetridge	.....	44	....	13	30
Meleney and Howes	.....	55	1	22	44
Milbert	1,560	20	1.3	11	55
Singleton and Blocker	0,000	61	0.67	19	31.15
Starr and Nason	2,455	15	0.61		
Totten	19,473	47	0.24	19	40
White	.....	34	....	17	50

from the records of Lenox Hill Hospital ten cases in the last five years. (This does not include private cases.) Maes, Boyce and McFetridge[43] (1934) report forty-four cases which occurred in the last ten years (1924–1934) in New Orleans Charity Hospital. Grace[20] (1934) reports thirty-six cases from the records of First Surgical Division of Bellevue Hospital for the past fifteen years. Colp[10] (1934) reports twenty-six cases from a series of 2,750 consecutive laparotomies from Surgical and Gynecological Services of Mount Sinai Hospital. Meleney and Howes[45] report fifty-five cases (incidence of 1 per cent) from Surgical Service of the Presbyterian Hospital in New York in the eight years from 1926 to 1934. White[66] (1934) reports thirty cases from the Roosevelt Hospital, New York. Heyd[25] (1934) reports four cases in 2,125 personal cases, and four in one year in 1,000 consecutive clinic cases. In 7,903 consecutive laparotomies performed at the Henry Ford Hospital, Fallis[15] (1937) reported fifty wound disruptures—an incidence of 0.64 per cent. Glenn[19] (1937), analyzing, 2,927 abdominal operations, found twenty-two cases of evisceration—an incidence of 0.75 per cent. From a total of 19,473 consecutive abdominal operations performed at the Los Angeles County Hospital, Totten[63] (1938) reported forty-seven wound ruptures—an incidence of 0.24 per cent.

Age. No period of life appears to be exempt. The greatest incidence in our series was in the fourth and fifth decades. This is to be expected since it is during this twenty year period that most surgical operations are done and one in which abdominal carcinoma is more frequent and subject to exploration. In our series the youngest was 10 (splenomegaly), the oldest 68 (carcinoma of stomach). Jenkins,[30] reviewing 1,294 reported American and European eviscerations, found the average age to be 44 years, and in his reported series of thirty-six cases, three were infants 2 to 4 months old.

Sex. Sokolov collected and reviewed 730 eviscerations and found that it occurred twice as frequently in men as in women. In the fifty-five cases reported by Meleney and Howes there were thirty-six males and fourteen females. In contrast, Madelung[42] reporting 157 eviscerations from a European clinic, states that wound rupture occurs three times as commonly in women as in men. Colp in his twenty-six cases reports male fourteen, female twelve, a ratio of 7 to 5. Maes, Boyce and McFetridge in their forty-four cases, report twenty-one male, twenty-three female. In Jenkins' summary of 1,294 cases, 649 were in males (57 per cent); 482 (43 per cent) in females. *In our series* fourteen were female, twenty male.

Seasonal Variation. Sokolov was induced to believe that the season of the year exerted a direct influence on the incidence of wound evisceration. His statistics proved that most wound separations occurred during the winter and spring months. Colp in his twenty-nine cases found no seasonal relationship. *In our series* the highest incidence was in summer, the lowest incidence in the fall.

Mortality. In the cases reviewed the mortality varied from 16 to 75 per cent. Colp gives 28 per cent; Meleney and Howes, reporting forty cases, give a mortality of 44 per cent; Grace, reporting thirty-six cases, gives a mortality of 41 per cent, and White, reporting thirty cases, gives a mortality of 53 per cent; Glenn[19] (twenty-two cases) 45 per cent; Fallis (forty-nine cases) 34 per cent; Milbert (twenty cases) 54 per cent. There were thirteen deaths in Jenkin's series of thirty-six cases—a mortality of 36 per cent; and in his analysis of 1,294 cases, the average mortality was 35 per cent.

In our series of thirty-four cases, seventeen recovered, seventeen died, giving a 50 per cent mortality. Of the seventeen who died, nine had carcinoma; of the seventeen who recovered, three had carcinoma. Analysis of these cases makes it quite clear that most of them did not die because their wounds ruptured, although it is correct to assume that many times

the accident precipitated the fatality. Many of the cases would have terminated fatally even if the complication had not occurred.

Primary Diseases and Evisceration. Analysis was made to see if there was any relation between the diseases for which the patient seeks surgery and the incidence of evisceration. While the number of cases is small, the frequency of evisceration in certain conditions was of interest. *In our series* of thirty-four cases, twelve patients had carcinoma, of whom nine died and three recovered. Of the nine that died carcinoma was present as follows: generalized, one; pancreas, one; stomach, four; intestine, three. In the three that recovered carcinoma was present as follows: rectum, one; stomach, one; ovary, one. Seven had ulcers of the stomach or duodenum, four had gall-bladder disease, three had fibroids, three had appendicitis (two acute and one chronic), one had an ovarian cyst, one splenomegaly, one a ventral hernia, and two pregnancies requiring cesarean section.

In Colp's series, malignant tumors were responsible for 28 per cent of eviscerations, inflammatory diseases of bile passages for 23 per cent, gynecological diseases, as fibroids, 19 per cent. Starr and Nason,[61] in 2,245 laparotomies, had fifteen eviscerations or 0.61 per cent, and it is interesting to note that 40 per cent of these occurred following operations for carcinoma; that out of 135 laparotomies for carcinoma the incidence for evisceration was 4.4 per cent, again emphasizing the increased frequency of evisceration in this condition.

In Jenkin's series of thirty-six cases, nineteen had abdominal malignancies; of the nineteen malignancies there were ten carcinomas of the stomach, four of the rectum, three of the pancreas, and two of the colon. In the summary of data on 1,294 eviscerations Jenkins found 296 or 25 per cent followed operation for malignancies, 12 per cent following biliary tract surgery, and 18 per cent following gynecologic procedures. Meleney and Howes, in their series of fifty cases, showed the greatest incidence following biliary and gastric surgery, sixteen cases followed gastric surgery, fourteen cases followed biliary surgery. Malignant disease was responsible for 27 per cent of Glenn's series of twenty-two cases.

Table II

Incidence of malignancy in disrupted and eviscerated cases

Author	Disruption and Evisceration	Carcinoma	Per Cent
Bettman and Lichtenstein	32	6	19
Colp	29	8	27.6
Eliason and McLoughlin	25	6	24
Fallis	50	8	16.3
Glasser	8	0	0
Glenn and Moore	22	6	27
Grace	46	10	21.8
Jenkins	36	19	53
Koster and Kasman	17	2	11.8
Maes, Boyce and McFetridge	44	5	11.4
Meleney and Howes	56	19	34
Milbert	20	8	40
Singleton and Blocker	61	4	6.5
Starr and Nason	15	6	40
Totten	47	7	15
White	30	5	16.6
Bowen	34	12	35.2
Total or average	572	131	23.5

Table III

Incidence of disruptions and eviscerations in malignant diseases

Author	Laparotomies in Malignancies	Disruptions and Eviscerations	Per Cent Incidence	Laparotomies	Per Cent Incidence
Colp	316	7	1.20	2,750	0.9
Glenn and Moore	582	6	2.2	2,927	0.75
Starr and Nason	135	6	4.4	2,455	0.61

It is apparent that the largest group of cases occurred in patients having carcinoma of an abdominal viscus. This tends to confirm the usual surgical impression that in diseases accompanied by cachexia,

the wound tends to heal more slowly and when these are subjected to increased intra-abdominal pressure, the wound frequently gives way. Certain benign growths such as fibroids are often attended with harmful systemic effects, as for example hemorrhage and cardiac decompensation.

The frequency also of evisceration in patients with peptic ulcers and gall-bladder disease is due to the factors of vomiting, hiccough, distention, infection and associated liver pathology rather than to the patient's state of nutrition. Statistics from the literature agree with our findings.

In our series, evisceration most frequently followed operations on the stomach. Eviscerations followed stomach surgery (ten times); gynecological and obstetrical surgery (seven); cholecystectomy (five); intestinal surgery (four); appendectomy (four); exploratory laparotomies for inoperable carcinoma (three); splenectomy (one).

In contrast to the frequency in our series of eviscerations in carcinoma, gastric ulcer and gall-bladder disease, we have the figures from Maes, Boyce and McFetridge's forty-four cases representing a period of ten years at the New Orleans Charity Hospital in which 50 per cent of their incidence was *in cases of appendicitis*. Ten of the twenty cases were drained. Still more confusion is added to this group because of the fact *that in six of these* the McBurney incision was used after which evisceration is seldom reported.

Previous Operations. Operations performed through previous scars have the reputation of being more likely to separate than those of a primary incision. Colp, in his series of twenty-six cases, reports one case of evisceration following secondary operation. He reports a series of sixty-one patients reoperated on through previous incisions without a single case of evisceration.

In our series it occurred in five cases in which previous scars were excised. One of these five patients had had nine previous abdominal operations. Another one eviscerated following two successive operations. On December 19, 1931 he was operated on for perforated duodenal ulcer and eviscerated six days later. One year later on December 6, 1932, he was operated for intestinal obstruction and eviscerated three days postoperatively. Multiple operations prolong the operating time, increase the trauma, necessitate enlarging the incision, vigorous traction—which may be contributing factors in the etiology of disruption. In Fallis' series of forty-nine eviscerations, thirty-six or 75 per cent, were subjected to multiple operations.

Preoperative Condition. In twelve cases the preoperative condition was good; in eighteen cases the preoperative condition was poor; two had active tuberculosis; one had had asthma for twenty-five years; five were obese; two had anemia requiring transfusion; two were emaciated; two dehydrated, and two had myocardial damage. In two cases, the history was incomplete as to preoperative conditions. Therefore, in more than one-half of the patients who eviscerated the preoperative condition was complicated by diseases named above.

Postoperative Course. The postoperative course of the eviscerated cases was analyzed to determine the extent to which postoperative complications were contributing or exciting factors in the production of evisceration. It must be admitted that in some the evisceration was the result of postoperative vomiting, hiccoughing, and distention. In other cases it was the cause of these complications. In only thirteen of the eviscerated cases was the postoperative course smooth.

The serious rôle which pulmonary complications play in abdominal surgery is well known and the part which they might play as the precipitating factors in evisceration is obvious.

Respiratory infections were the exciting agents in nine of the thirty-four eviscerations: asthmatic (two); bronchial pneumonia and later positive sputum for

tuberculosis (one); pleural effusion (three); bronchial pneumonia (one); and cough (two).

Persisting vomiting and distention requiring lavage and Connell suction were noted in thirteen cases. While vomiting usually precedes evisceration, one cannot lose sight of the fact that it may also be the result of partial obstruction of the eviscerated gut. Four patients precipitated their evisceration by undue exertion in the early postoperative days. One fell out of bed eight days postoperatively. One got out of bed three days postoperatively, one five days and a third six days postoperatively.

Persistent hiccoughing was noted in two cases. In general, it appears that the majority of our eviscerated cases had a stormy postoperative course, complicated most frequently by increased abdominal pressure resulting from distention, vomiting, hiccough, and cough.

Type of Incision. Colp states that the incidence of evisceration is fundamentally dependent upon the effects of the underlying disease rather than the incision per se. The incision is only incidental to the approach to the underlying pathology. In our series evisceration followed upper abdominal incisions in nineteen cases, lower abdominal incisions in fifteen cases. Evisceration has followed every type of incision and closure. Maes, Boyce and McFetridge reported six cases following the McBurney incision and one evisceration following operation for direct hernia. In the 1,294 cases compiled by Jenkins, 474 followed upper abdominal incisions and 450 followed lower abdominal incisions.

Anesthesia. It is quite evident that the type of anesthetic per se plays an insignificant part, but the *character* of the anesthesia—the degrees of relaxation, which permits adequate exposure and facilitates handling of viscera with minimum of trauma, and most important, which permits a closure of the abdominal wall without tension—is significant. Spinal has therefore been advocated because of the complete relaxation of the abdominal wall and intestines. Two of our patients had spinal, while practically all the rest had general ether anesthesia. The surgeon hesitates to incise the peritoneum with the patient rigid and straining, and he should be equally if not more hesitant to suture the peritoneum unless relaxation permits approximation of the peritoneum and posterior sheath without tension.

Closure. Layer closure was used in suturing the primary incision in all of our series, and in eight cases retention sutures were added: generally plain 2 continuous for peritoneum, chromic 2 interrupted for fascia, and silk or dermol for skin. From the literature, it appears that rupture apparently occurs quite as often with retention sutures as without them, which is not surprising since they do not enter the peritoneum—and the peritoneum is the layer in which rupture occurs first. Tension sutures tied too loosely give little support to the wound, and if tied too tightly cut through all the layers to some degree. Jenkins advises against using tension sutures in the presence of continuous catgut sutures, both because of the mechanical damage done to the continuous suture, and because of bacterial contamination extending along the tract from its introduction in the skin to its contact with the continuous catgut suture. Lahey,[39] Eliason[13] and Colp,[10] have eliminated the use of strangulating through-and-through stay sutures with a decrease in the liquefactive necroses, stitch abscesses, and definite improvement in wound healing.

In contrast, Kennedy,[32] reporting the combined surgical experience of himself and his predecessor, Dr. Joseph Price, during fifty-six years, states that during this time not a single evisceration occurred with the use of through-and-through silkworm sutures. Baldwin[2] makes the impressive statement that he performed 16,465 laparotomies using 2 chromic catgut throughout, without an evisceration. Howes and Harvey[29] have shown that the use of mat-

tress catgut sutures to close the fascia only increases the strength of the suture from 10 to 20 per cent, and does not warrant the increased amount of catgut.

Infection. In our series gross infection was present in only four cases. It must be granted that the characteristic case of evisceration is not associated with gross infection, though it must likewise be granted, as Howes and Harvey pointed out, that in the presence of infection, catgut rapidly loses its strength and is quickly absorbed regardless of chromicization.

When the infection is of low grade or of the nonsuppurative type it may be overlooked. The rapid digestion of chromic gut which has been frequently observed in apparently clean eviscerated wounds can be attributed to this low grade infection (Jenkins[30]). In the 1,294 cases reviewed by Jenkins an obvious infection of the wound was noted in 22 per cent of the eviscerated cases in which the condition of the wound was given.

Farr[16] relates an interesting sidelight on disrupted wounds reported at the Cornell Division of the New York Hospital during Dr. Gibson's tenure of office, viz., that in many hundreds of severely infected right rectus wounds with extensive peritonitis or abscess, the wounds were left wide open and packed with the Gibson-Mikulicz tampons. No sutures were used—and eviscerations were very rare. Technically, these wounds were all disrupted and practically, the patients recovered.

Drainage. Only six cases in our series required drainage. Theoretically, the institution of drainage should provide a ready-made exit for the protrusion of abdominal contents were it not for the fact that the organized adhesions which form snugly about the drain seal the space about it. In Colp's series the incidence of evisceration in drained cases was 1.22 per cent as compared with 0.84 per cent in undrained cases. Meleney and Howes' series of fifty cases showed a higher incidence of eviscerations in undrained than drained cases. It must be remembered, however, that the total number of drained abdominal wounds is very much lower than those not drained.

TABLE IV
INCIDENCE OF DISRUPTIONS AND EVISCERATIONS IN RELATION TO DRAINAGE

Author	No. of Incisions	Drained	Incidence of Disruptions	Not Drained	Incidence of Disruptions
Colp.....	2,750	1,147	13 (1.22 per cent)	1,603	13 (0.81 per cent)
Singleton...	9,000	1,816	18 (0.99 per cent)	7,184	43 (0.59 per cent)

In Jenkin's series of 1,294 American and European eviscerations, 153, or 17 per cent, were drained. In the American series a third of the reported cases were drained. Jenkins reminds us that "the use of a drain usually implies the presence of infection and therefore the presence of the intraperitoneal infection is of more significance as an etiological factor than the drain itself."

Since catgut is rapidly digested in the presence of infection, the tensile strength and continuity of a continuous suture in contact with the draining wound would be destroyed long before adequate healing had occurred in the rest of the wound. Jenkins suggests therefore that when feasible a separate stab incision be made for drainage or interrupted sutures be used for closure. Even when a drain is used as a precautionary measure as in cholecystectomy, he draws our attention to the possibility that the drain may permit bacterial contamination from the skin to the depth of the wound which may hasten catgut digestion.

Day of Rupture. It is interesting to note the frequency with which evisceration is recorded immediately following removal of skin sutures. In our series twenty-seven of the thirty-four eviscerations occurred between the sixth and seventh day. The greatest number occurred on the sixth postoperative day. One case (cecostomy) eviscerated one

foot of the colon one day postoperative. Meleney and Howes report thirty-two of their fifty cases occurring between the seventh and tenth day. But disruption can occur at other times. Colp, Grace, Meleney, and Howes, report the accident on the second and third postoperative days. In thirteen of the cases collected by Sokolov, it occurred after the twentieth day, in one instance as late as the twelfth year postoperatively. In seven of Maes, Boyce and McFetridge's series of forty-four cases it occurred after the fifteenth day. Three of their patients who had been discharged from the hospital returned on the third, fourth and the seventy-fifth day following discharge with ruptured wounds. In Jenkin's series of 1,294 collected cases the average time of evisceration was 8.3 days postoperatively.

Does evisceration actually occur then? Is evisceration a suddenly developed complication? It is a common belief that the evisceration of a wound is a process that occurs simultaneously throughout the wall. To the contrary, evisceration is usually a process that occurs slowly and in steps. Ries[55] has pointed out the following facts: "Examination of the wound edges immediately after evisceration will show signs of bleeding in the skin edges but nowhere else. The peritoneum, muscle and fascial layers will be edematous, matted together with the appearance of chronic inflammation and no evidence of recent injury."

It is my belief that eviscerations are erroneously being recorded as occurring most frequently between the sixth and tenth day which coincides with the usual time of removal of skin sutures. I believe that when the skin sutures are removed the underlying eviscerated bowel is born to view and that the evisceration was completed days previously as evidenced by the adhesions and fibrous exudate covering the intestines, the omentum and peritoneum.

Eviscerated Contents. The small intestines and omentum were most frequently found as the eviscerated contents in our series. In three instances the large bowel eviscerated. In one case the stomach and small intestines, and in one case the liver, stomach and small intestine were eviscerated.

Table V

ANALYSIS OF DATA ON THIRTY-FOUR EVISCERATED CASES

- Age. 40–50
- Sex
  - Male—20
  - Female—14
- Deaths—17
- Mortality—50 per cent
- Primary disease
  - Carcinoma found in 12 cases (35.2 per cent)
    - Generalized—1
    - Pancreas—1
    - Stomach—5
    - Intestine—4
    - Ovary—1
  - Gall-bladder disease—4
  - Gyn. and Obst.—6
  - Appendicitis—3
  - Stomach and duodenum—7
  - Spleen—1
  - Ventral hernia—1
- Excision of previous scars—5
- Preoperative condition
  - Good—12
  - Poor—18
- Postoperative course
  - Respiratory infections—9
  - Persistent vomiting and distention—13
  - Undue exertion—4
- Incisions
  - Upper abdominal—19
  - Lower abdominal—15
- Anesthesia
  - General—32
  - Spinal—2
- Infection—4
- Drainage—6
- Closure
  - Layer—26
  - Layer plus retentions—8
- Treatment. Through-and through silkworm—21
  - Secondary suture—32. Through-and through plus layer—6
  - Layer closure—5
  - Adhesive strapping—2

DIAGNOSIS

A majority of cases of disruption are not recognized or even suspected until the skin gives way and a viscus protrudes.

Separation of the deeper layers of an incision may often be diagnosed by the presence of a slight fulness or bulging of the wound during the postoperative

period, even though the skin appears perfectly healed. Careful separation of the skin edges discloses the presence of omentum immediately beneath the skin. More frequently, however, one's attention is called to this complication by the *presence of a serosanguinous discharge*. Totten[63] reported that serosanguinous discharge preceded evisceration in 44 per cent of his forty-seven cases. Less frequently the patient may suddenly experience severe pain in the operative site while straining, retching or vomiting, and complete rupture may occur suddenly without warning.

Clinically these patients often continue to have abdominal discomfort after the third postoperative day. Distention after repeated enemas, hiccough and belching is frequent. Symptoms suggestive of partial intestinal obstruction predominate. Such a symptom complex should always lead one to inspect the wound for possible evisceration.

TREATMENT

The two chief methods of dealing with an evisceration are packing and secondary suture.

Tampon treatment is a method of choice in infected cases, and in those desperately ill in whom evisceration has occurred secondary to generalized peritonitis. It consists of gently replacing the contents within the abdomen and packing the gaping wound snugly with plain or iodoform gauze. The wound edges are approximated with a few adhesive strips. Healing requires about thirty-seven days as a rule. Colp reports that in nineteen cases treated by tampon, eleven developed hernia. This is a serious objection to tampon treatment.

Prompt secondary suture of the abdominal incision has been recommended as the most satisfactory method of treatment. Heavy silk, silkworm gut, and silver wire are the suture materials most commonly used. The sutures are usually interrupted and placed through-and-through all layers of the abdominal wall. Lahey, Starr and Nason, state that peritoneal infections following wound rupture is rare in their experience and for this reason advocate closing the wound without drainage.

In our series of thirty-four cases, twenty-one had through-and-through silkworm suture; six cases had through-and-through plus layer closure; five cases had layer closure only; two had no suture but were strapped with adhesive.

Of the seventeen patients who recovered following secondary suture, thirteen were followed up—and five of the thirteen developed ventral herniae.

ETIOLOGY AND MECHANISM

Colp[10] believes that the primary disease is the most important factor underlying the etiology of evisceration. While it is true that evisceration may occur in any disease affecting the peritoneum or its contents—it is definitely associated more frequently with some lesions than with others. Our series has shown a definite relation between incidence of evisceration and carcinoma. It would seem logical to suppose that illnesses of a protracted nature attended by emaciation, anemia, cachexia, might devitalize the patient sufficiently to interfere with reparative powers and wound healing. Yet if we are to conclude that the recuperative power of the patient is a factor in the causation of evisceration it is difficult to explain the paradoxical condition of *failure of the primary suture* and *success of the secondary closure*. Grace[20] reported that of twenty-eight cases that required secondary suture, in only two cases did the wound fail to heal and a rerupture occur.

Erdmann[14] ascribed disruption of wounds to "tissue hunger" with resulting rapid digestion and absorption of catgut. Clute,[9] Meleney and Howes[45] believe that the solution of the problem lies in the attention paid to the actual direct suturing of the peritoneum and posterior sheath. Harvey[23] ascribes the three essential reasons for disruption of wounds to: (1) failure properly to close the posterior

rectus sheath; (2) the accumulation of serum in dead spaces; and (3) the use of catgut of too large a size and in too large a quantity, which increases the exudative reaction and delays the onset of fibroplasia.

TABLE VI

SUMMARY OF DATA ON 621 AMERICAN WOUND DISRUPTIONS AND EVISCERATIONS

	No. Cases	Average Age	Per Cent Male	Per Cent Female	Per Cent Malignant	Per Cent Biliary Tract	Per Cent Stomach and Duodenum	Per Cent Gyn. and Obst.	Per Cent Appendix	Per Cent Mortality	Per Cent Infection	Per Cent Upper Abdominal Incision	Per Cent Lower Abdominal Incision	Per Cent Drained
Bowen	34	45	59	41	35.2	11.76	20.6	17.6	9	50	12	56	44	18
Fallis	50	45	55	45	16.3	20.4	14.3	28.6	16.3	34	20	53	47	38.5
Glenn and Moore	22	50	91	9	27	27	13.5	0	3.5	45.5	27.2	68	32	36.3
Hinton	19	42	70	30	10.5	37	60	0	0	21	16	95	5	21
Singleton and Blocker	61	36	27	73	6.5	10	3.25	65.5	11.5	31	60.7	15	85	29.5
Totten	47	45	80	20	15	7.2	15	8.5	6.4	40	36	51	49	
Total and average	232	44	63.6	36.4	18.4	18.86	21	20.3	7.8	36.9	28.6	56.3	43.7	28.6
Jenkins—Review of 389 American cases	389	46	63	37	26	19	14	12	12	39	34	59	41	31
Total 621 American cases and average percentage	621	44.5	63.3	36.7	22.2	18.9	17.5	16.1	9.9	37.9	31	57.6	42.3	29.8

Kraissl,[37] Hinton,[26] and Babcock[1] have shown that allergic reactions to catgut proteins and sensitivity to chemicals used in processing chromic gut may be factors responsible for more rapid digestions of catgut in some patients. Kraissl carried out a controlled series of experiments in guinea pigs previously sensitized to catgut and reported that 35.7 per cent disrupted their abdominal wounds; 32.1 per cent healed abnormally, and 32.1 per cent healed normally. He also sensitized guinea pigs to chromic acid and 25 per cent disrupted; 37.5 per cent had abnormal healing and 37.5 per cent healed normally.

If we recall that catgut is a foreign protein it seems logical to assume that a certain percentage of patients might be considered allergic to it.

Jenkins,[30] Clute,[9] Meleney and Howes[45] stress the importance of adequate closure of the posterior rectus sheath in minimizing the incidence of evisceration. Milbert[46] and Glasser[18] emphasize the rôle of increased intra-abdominal pressure as the underlying factor in the etiology of eviscerations.

Thompson,[62] Ravdin[53] and Whipple[65] have noted that deficiency of blood proteins retards healing and enhances wound disruption. Whipple states that diminished serum proteins of the blood and tissue and vitamin deficiencies prevent normal healing in many of the elderly patients. Wallboa (1926) demonstrated that wounds in animals with scurvy will not heal. Lund at Boston City Hospital finds a great number of patients with miscellaneous surgical conditions also run suboptimal levels of vitamin c—many of the levels approximately close to scurvy.

If other biochemical factors are responsible for the delayed wound healing the nature of them are at present unknown.

The most reasonable theory yet advanced as for the mechanism of evisceration is that of Freeman.[17] His idea is that through an opening in the peritoneal layer which may be present as a result of inadequate closure or develop as a result of increased intra-abdominal pressure due to distention, vomiting, hiccoughing, coughing—the sutures tear through the peritoneal layer, a wedge of omentum

protrudes early postoperatively and the piston-like action of the omental wedge forcibly and intermittently thrust by the respiratory excursions, vomiting, coughing, and hiccoughing, makes the opening larger and larger, permitting not only omentum but intestines to protrude. The theory is plausible because of: (1) the usual tendency of the omentum to enter and fill the wound cavity when primary closure is undertaken; (2) omentum is practically always present in eviscerated wounds; (3) the swollen state and the associated adhesions suggest that the prolapse has occurred sometime previously rather than at the time of suture removal; (4) the incarceration of the omentum and intestines is manifested clinically by the symptoms of obstruction which frequently appear very soon after operation.

Suture Material. Since we are relying on the protein of a sheep's intestine to maintain approximation of incised tissues, it behooves us to acquaint ourselves with the extrinsic and intrinsic factors in manufactured catgut which may affect the tissues locally and generally—influencing absorption, digestion, tissue reaction, and allergy.

Catgut is made from twisted ribbons of the submucosa of sheeps' intestines. It is a collagen which is markedly hygroscopic, and when brought into contact with water, it rapidly absorbs moisture, softens, and swells. Boilable catgut is completely dehydrated and kept in tubing fluid of anhydrous toluol. Consequently, boilable catgut is stiff, wiry, inflexible, and must be moistened to restore its pliability. Prolonged immersion in water before use causes considerable swelling of the collagen, and decreases its tensile strength. Soaking boilable catgut in hot water is dangerous, since it hydrolizes the collagen and destroys its tensile strength (Davis and Geck[11]).

To date there are no tests that can determine whether a given brand of catgut will or will not resist absorption for a sufficient length of time for it to be reliable for all requirements of suture material. In numerous cases of this series the operators on resuture reported the complete digestion of catgut after the third to fifth day. While the question of absorbability of catgut is of great importance, yet the committee of catgut standards of the American Medical Association has not been able to persuade catgut firms to agree on any standards to which they can or will make their products conform.

Because boilable gut is completely dehydrated it absorbs more of the digestive media than the non-boilable variety, and according to Kraissl[36] non-boilable gut may be depended to remain in the tissues longer than the boilable catgut.

Non-boilable gut is basically prepared the same as the boilable, but placed in tubing fluid of 95 per cent alcohol and 5 per cent water. A smooth flexible gut is produced which requires no soaking before use.

It is not considered good technique for the surgical nurse to test the tensile strength of the suture before handing it over to the surgeon. A few sudden pulls or jerks are similar to the method used in breaking the cord after tying a parcel, and may so weaken the suture as to permit it to break under slight tension when in use.

The customary terms "ten day," "twenty day" catgut are used to indicate the absorption time of the suture when embedded in normal muscular tissues of aseptic wounds. The manufacturers[11,31,40] specifically state that in mucous and serous membranes it will last from *one-third to one-half* of this period. It is paradoxical therefore that it has been customary to use plain for peritoneum and chromic for fascia. Since the peritoneum is a serous membrane it is suggested that No. 0 or No. 1 forty day chromic gut be used for peritoneal closure.

In suturing other serous covered viscera we are meticulously careful to use atraumatic needles. Yet, frequently in suturing

the thin, friable, single mesolethial layers of peritoneum, large bayonet-shaped needles carrying two thicknesses of catgut stab the peritoneum, and wound and puncture it unnecessarily. The writer suggests the use of the curved atraumatic needles carrying 0 or 1 forty day chromic for peritoneal suture.

There is no point in introducing a suture into a tissue which has a greater tensile strength than the tissue itself (Harvey).[23] Catgut is a foreign protein and is absorbed by an exudative reaction, which, when excessive delays wound healing. To diminish the exudative reaction it is most advisable to bury the least amount of catgut within the tissues. Harvey reminds us that we have an exaggerated idea of the holding power of fascia in respect to the size of catgut used. He states that No. 1 or No. 2 chromic gut is about *ten times* stronger than the holding power of fascia itself. Harvey believes it is ridiculous to use 0 plain for approximation of fat tissue since fat itself has no holding power. The finest possible plain suture (No. 000) is more than sufficient to approximate fat. Howes[28] reminds us that the tensile strength of 0 chromic gut is greater than the holding power of any tissue likely to be sutured with it.

The most graphic demonstration of tissue reaction, catgut absorption, and healing with respect to size of catgut used was given by Bower[5] at the 1938 convention of the American Medical Association. Transparencies showing the results of sutures of stomach and intestine and photomicrographs showing tissue reaction and absorption rate of one and five zero chromic were demonstrated. There was a most marked local reaction; tissue union was delayed; absorption more rapid in using the coarser gut. The very fine five zero gut lasted longer, caused a minimum of local tissue reaction, more rapid healing and more complete healing than No. 1 chromic. One left the exhibit with a determination to use smaller sizes of catgut in the suture of tissues generally.

Recently experiments were reported in the attempt to adopt other animal proteins for suture materials. Bost[4] originally prepared "carnofil" a suture material made from the muscle tissue of the horse. It is said to be relatively free from bacteria and can be subjected to unlimited sterilization.

Preobrazensky[51] has used dogs' nerves removed aseptically, treated with 20 per cent acetic acid, twisted and sterilized, for intestinal sutures. Sidelnikoff[57] suggested the use of sutures made from the umbilical cord.

The chemical treatment of catgut for sterilization and control of absorption time merits study and consideration.

Clock[7] has detected non-sterility of 62½ per cent of twenty-four foreign brands of catgut and 50 per cent of twelve American brands. Clock came to the conclusion that chemical sterilization of catgut is inefficient and unreliable when subjected to careful bacteriologic examination and that controlled heat sterilization is the only positive method of sterilization of catgut sutures. Moreover Clock remarks that the embedding of metallically impregnated catgut frequently causes irritant action on the tissues—with excessive cellular activity and consequent hastened digestion and absorption of the catgut. Sensitivity to chromic acid has been reported by Kraissl.[37]

Reduction of the amount of catgut under the subcutaneous tissue has been the most important factor in reducing the incidence of serum collections.

The essentials of good suturing include the use of small size catgut. The advantages of using small sizes of catgut sutures are (Davis and Geck[11]):

1. They cause less trauma to the tissue at insertion than do coarser sutures.

2. They permit smaller knots, with less foreign protein.

3. They permit better approximation of tissues.

4. They decrease the sum total amount of foreign proteins; result in a minimum of

exudative reaction; favor more rapid and complete wound healing.

Absorption time may be altered by tanning, chromicizing, treatment with formalin, iodine, impregnating with mercury, silver and copper. The most resistant catgut is produced in foreign countries where it is frequently hardened with formalin. Kraissl[35] found that foreign gut hardened with formalin remained unchanged after three weeks. In Germany, Haefen[21] reported that iodized catgut absorbed very slowly, and remained in the tissues as long as four months.

The larger sizes of catgut do not necessarily last longer than the smaller sizes. The digestive enzymes penetrate between the twisted ribbons and digest each separately. In chromic gut, the chromicizing may be on the outer layer only, and when this is penetrated, digestion is rapid; while in the smaller sizes the chromicizing extends through the entire strand (Kraissl[36]).

In the presence of infection catgut is absorbed with the utmost rapidity. When catgut sutures are embedded in the tissues of persons allergic to catgut, premature absorption may occur.

Absorption time varies according to the nature of the tissues in which the sutures are imbedded. A well known manufacturer[40] of iodized tanned catgut states that the suture is more quickly absorbed in mucous and serous membranes—lasting from *one-third* to *one-half* the time it would if buried in muscle. Thus, a tanned "twenty" day suture would last only seven to ten days when buried in the peritoneum—since the peritoneum is a serous membrane.

In the repair of a lacerated perineum or cervix, any catgut, whether chromicized or not, will be digested and absorbed with greater rapidity than when buried in aseptic wounds, because of the digestive action of the enzymes in the cervical and vaginal secretions. Therefore, forty day chromic catgut is preferred for repair of the perineum, cervix and vagina. Hess[24] remarks that it should never be necessary to use gut larger than No. 1 chromic, and reports the routine use of No. 00 chromic interrupted sutures in approximating episiotomy incisions and perineal lacerations.

Another well known manufacturer[11] states that No. 1 plain catgut loses its tensile strength in four and one-half days; No. 2 plain in five days. For practical purposes, a suture whose tensile strength is lost, can be considered as absorbed, although as a rule, complete absorption occurs about three days after complete loss of tensile strength.[11] Jenkins[30] conducted clinical tests on the duration of tensile strength of catgut and concluded that "plain catgut lasts five to six days by tension suture tests, but that it becomes untied in the tissues in two to three days."

Five days is too short a time to hold the peritoneum during the postoperative vomiting, distention, and respiratory complications with its accompanying increase in intra-abdominal pressure and tension on the peritoneal suture line. Since chromicized gut maintains its tensile strength regardless of size, the writer again urges the use of No. 1 forty day chromic for peritoneal closure.

During the past few years there has been a noticeable trend in the literature to rely more on non-absorbable material for sutures—particularly silk and metal alloys. Meleney,[45] Howes,[28] and Whipple,[65] believe that silk is a better suture material than catgut in clean cases. Maes, Boyce and McFetridge[43] remark that catgut used with the silk technique is probably as safe as silk. Silk should not be used in infected cases.

The use of metal wire appears to be gaining favor with surgeons in various parts of the world. Reid, Zinniger and Merrell[54] reported brilliant results in the use of silver wire. Babcock[1] has recommended the use of "Nobel" metal—an alloy of stainless steel wire. In France, Minine[47] employs an alloy called "nickeline" in gynecological operations.

Wound Healing. From experimental studies, Meleney and Howes[45] found that "the healing of a wound is disturbed only by profound systemic changes, but locally, healing is readily delayed by a retardation of the phase of fibroplasia as a result of excessive exudative reaction." Any factor which increases the exudative reaction delays wound healing. Infection, trauma, the presence of dead tissue such as blood or suture material act for the most part by retarding the onset of fibroplasia, rather than by inhibiting the growth of fibroblasts once initiated. These observations emphasize again the necessity for gentle handling of tissues, perfect hemostasis, and burying the least amount of suture material to decrease the exudation and hasten the onset of fibroplasia.

During the first or exudative phase of wound healing, the tissues are dependent for its approximation upon the suture material. In the second, or stage of fibroplasia, the wound begins to develop its own holding power. During the period when the wound itself is weakest, the sutures are strongest; and when the sutures begin to lose their strength the wound becomes increasingly strong.

Ogilvie[49] states "that a well sutured wound has a tensile strength of about 40 per cent of that of the tissues before they were cut. During the first few days the tissues undergo autolysis, while the sutures are being digested. By the fourth day the strength of the wound has dropped to some 20 to 25 per cent of the original. From the fifth day onward fibroblasts are laid down rapidly, and the strength increases; so that by the sixth day it is 50 per cent; and by the tenth day about 90 per cent of the normal."

Catgut is absorbed by an exudative reaction an excess of which retards fibroplasia and delays wound healing. *Bury the least amount of catgut to promote and hasten wound repair.*

The tragedy of evisceration is due not to the separation of the wound layers per se—but rather to the *intestinal obstruction* which results from the kinking and knuckling of loops of intestine which found their way through an opening in the peritoneum and became adherent to muscle or fascia. If the obstruction is relieved early enough —the patient recovers, whether we suture the wound or pack it with gauze. *Intestinal obstruction kills the patient—not the separation of the tissue layers.*

How many patients have separation of the deeper abdominal layers without obstruction of intestinal loops—or which develop incisional herniae, it is difficult to state. A majority of the patients with incisional hernias are unaware that they were on the borderline of eviscerations.

Neuhof[48] remarks that "postoperative incisional hernia may well be referable, in part at least to rupture with evisceration whose results may not be noted until months after operation."

King[33] in a study of 150 cases of incisional hernias found that 40 per cent of the hernial develop within a month after surgery. *Incisional hernia is frequently a delayed evisceration.* In many cases the abdominal contents lie directly in the superficial fascia or under the incisional scar. The symptoms are mild or severe depending upon the dragging and kinking of the adherent visceral contents.

Were it possible to maintain the integrity of the peritoneal suture line during the postoperative period—then even if all other layers gave way—there would be an absence of the morbid intestinal obstruction which kills the patient. The intact peritoneum is able to withstand increased intra-abdominal pressure.

As surgeons we perform this experiment in every laparotomy. We incise all layers down to peritoneum—yet even when the patient is having a stormy anesthesia—straining, coughing—we observe the peritoneal layer flap as a sail in the wind with changes in the intra-abdominal pressure. But once the peritoneum is incised, it frequently takes four hands and as many sponges to retain the viscera within the abdomen.

It is my humble opinion that if we were able to approximate carefully the incised

peritoneum with a suture which would remain long enough to tide the patient over the postoperative period—and if it were possible to maintain the equilibrium of that peritoneal suture line long enough to permit healing by minimizing those factors which produce increased intra-abdominal pressure; and utilize incisions, approaches, and closures which support the peritoneum from without—then we should be decreasing the incidence and mortality of eviscerations. As long as the omentum and intestinal coils slide along peritonealized surfaces the incidence of obstruction is minimized. Large scrotal and ventral hernias can hold a considerable volume of intestinal contents within their sacs—and only occasionally become obstructed. But once the omentum or intestine leaves the peritoneal cavity it becomes adherent, kinked, and obstructed.

In stressing the importance of the peritoneal layer, I do not underestimate the rôle of increased intra-abdominal pressure, but rather emphasize the effect of increased intra-abdominal tension against a peritoneal incision which has been inadequately sutured, or approximated by a suture which was too rapidly absorbed in cases complicated by a stormy convalescence.

PREVENTION OF EVISCERATION

Let us proceed to consider logically the measures suggested and advocated in preventing and minimizing the incidence of evisceration:

1. Preoperative preparation of cachectic, dehydrated patients by transfusions and intravenous fluids to improve their general condition, supply serum pro eins and blood volume.

2. Anesthesia which will give sufficient relaxation, permit exploration with a minimum of handling of the viscera, and permit closure of the peritoneum without tension.

3. An incision which will give the most direct approach to the pathology with a minimum of traction and trauma—the closure and approximation of which is favored by the position which the patient is to assume.

4. The protection of tissues from mechanical and chemical damage; clean cut dissections; the avoidance of mass ligations; perfect hemostasis.

5. The meticulous closure of the peritoneal layer together with the posterior rectus sheath with fine forty day chromic catgut on an atraumatic needle.

6. Burying the least amount of catgut in the tissues to minimize exudative reaction—using No. 1 forty day chromic for peritoneum; No. 0 chromic for fascia and muscle, and 000 plain for subcutaneous suture.

7. The use of through-and-through non-absorbable sutures alone or in combination with layer closure in cancer, gallbladder and stomach cases.

8. The prevention and suppression of postoperative restlessness and undue activity.

9. The early use of the Levine catheter, Connell suction, in the treatment of gastric dilatation, distention and vomiting.

10. Change of posture, CO_2 inhalations to decrease hypostatic pulmonary congestion and atelectasis.

11. Prompt investigation of persistent vomiting by inspection of the wound—probing if necessary to determine the possible presence of deep separation of the layers.

12. Immediate inspection of the wound when the patient reports "something having given way."

13. Recognition of a serosanguinous discharge as an important warning sign of the presence of an evisceration.

14. The prompt secondary closure of the eviscerated wound.

In the attempt to reduce the incidence of eviscerations especially in those cases where the incidence is known to be great, e.g., in carcinoma, stomach and gallbladder cases, surgeons have adopted various techniques in closure. Colp[10] advocates the use of interrupted heavy through-and-through braided silk sutures in closing median epigastric incisions made

especially for gastroduodenal ulcers and practically for all carcinomas of the stomach. White,[66] noting the success with which firm union was obtained on secondary closures with through-and-through sutures, was induced to adopt the same procedure with fresh wounds of suspected cases. Kennedy[32] uses no absorbable sutures in his wounds. The combined surgical experience of himself and his predecessor, Dr. Joseph Price, during fifty-six years, contained not a single case of evisceration with the use of through-and-through silkworm gut sutures. Baldwin[2] performed 16,465 laparotomies using No. 2 chromic throughout and silkworm gut for stay sutures without an evisceration. Mont Reid[54] has used a silver wire technique and reports that not a single evisceration occurred in 334 cases in which it was anticipated.

Because of the anatomic structure of the posterior rectus sheath, above the semilunar line, with its fibers running transversely, there is considerable difficulty in closure and frequent failure of holding in this layer. Clute,[9] Jenkins,[30] Pool,[50] Meleney and Howes[45] considered failure of this layer to hold as an important factor in the etiology of eviscerations. For the same reason, numerous operators, Sloan,[59] Mayo,[44] Singleton,[58] Whipple,[65] have adopted transverse incisions to approach upper abdominal pathology. A transverse incision permits approximation of the posterior sheath without tension, and the position which the patient assumes favors the closure of a transverse wound. Mayo advises the use of a longitudinal with a connecting horizontal incision for epigastric lesions.

Singleton, reviewing 9,000 consecutive abdominal operations at the John Sealy Hospital, presented facts to prove the disappearance of disruptions and postoperative herniae since the adoption of transverse approaches to both upper and lower abdominal procedures.

TABLE VII

SUMMARY OF DATA ON 1,526 CASES OF WOUND DISRUPTIONS AND EVISCERATIONS
(905 European and 621 American Cases)

	No. Cases	Average Age	Per Cent Male	Per Cent Female	Per Cent Malignant	Per Cent Biliary Tract	Per Cent Stomach and Duodenum	Per Cent Gyn. and Obst.	Per Cent Appendix	Per Cent Mortality	Per Cent Infection	Per Cent Upper Abdominal Incision	Per Cent Lower Abdominal Incision	Per Cent Drained
Jenkins—Summary of 389 American and 905 European cases	1249	44	57	43	25	12	15	18	15	35	22	51	49	17
Bowen—Summary of 232 American cases	232	44	63.3	36.4	18.4	18.86	21	20.3	7.8	36.9	28.6	56.3	43.7	28.6
Total and average percentage	1526	44	60.3	39.7	21.7	19.43	18	19	11.4	35.9	25.3	53.6	46.4	28.2

TABLE VIII

INCIDENCE OF DISRUPTIONS AND HERNIA IN VERTICAL AND TRANSVERSE INCISIONS (SINGLETON)[58]

Incision	No.	Disruptions	Hernia
Vertical	292	9 (3.08 per cent)	16 (5.47 per cent)
Transverse	470	0	1 (0.21 per cent)

Singleton, reviewing 9,000 consecutive abdominal operations at the John Sealy Hospital, presented facts to prove the disappearance of disruptions and postoperative herniae since the adoption of transverse approaches to both upper and lower abdominal procedures.

SUMMARY

1. Certain primary diseases, especially cancer and operations on the stomach and biliary tract, predispose to evisceration.

2. In a majority of the eviscerated cases, the preoperative condition was poor; and the postoperative course complicated by distention, vomiting and cough.

3. Evisceration has followed every type of incision and closure.

4. The tragedy of evisceration is due to its complicating intestinal obstruction.

5. The mortality in eviscerated cases is high—16 to 75 per cent.

6. Evisceration takes place in the first few postoperative days and is *born to view* usually at the time the skin sutures are removed.

7. A hiatus in the peritoneum due to inadequate closure; early absorption of catgut; increased intra-abdominal pressure, permit the intra-abdominal contents to escape.

8. To Jenkins[30] series of 389 American and 903 European cases, the author has added 232 additional American cases and tabulated the data on the total of 1,526 cases.

CONCLUSIONS

1. Careful preoperative preparation is necessary—transfusions in debilitated cases to restore blood proteins and volume.

2. Spinal or epidural anesthesia is used for relaxation to minimize handling of the viscera and avoid vigorous traction.

3. More frequent use of transverse incisions in upper abdominal approaches is advocated.

4. In carcinoma cases, gastric and biliary surgery layer closure is preferably reinforced by non-absorbable through-and-through sutures.

5. The posterior rectus sheath should be identified and included in the peritoneal suture in upper abdominal closures.

6. No. 1 forty day chromic is advocated for meticulous peritoneal closure, preferably on an atraumatic needle.

7. The equilibrium of the peritoneal suture line must be maintained long enough to permit healing by: (1) using a suture which will maintain its tensile strength for an adequate time; (2) recognition and immediate energetic treatment of complications, such as distention, vomiting, cough, and restlessness, which increase intra-abdominal pressure.

8. Prompt inspection of the wound should be made in persistent postoperative vomiting and the presence of a serosanguinous discharge should lead to a suspicion of evisceration.

9. The most common method of treatment of eviscerations is secondary closure with through-and-through non-absorbable sutures.

10. Acquaintance with the intrinsic and extrinsic factors in the varieties of manufactured catgut will lead to their more intelligent use.

11. A plea is made for the use of the finer sizes of catgut to enhance the "*art in sutures*"; to decrease the exudative reaction and hasten healing of abdominal wounds.

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THE SUPERIORITY OF VERY FINE CATGUT IN GASTROINTESTINAL SURGERY*

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FOR many years we have believed that the trauma induced by the passage of the usual large atraumatic needle with large sized catgut through delicate membranes is excessive. The objective of this research was to eliminate or reduce this trauma and tissue reaction, and to overcome some of the mechanical difficulties in securing accurate apposition and complete hemostasis of membranous tissue of the gastrointestinal tract. A reliable manufacturer† of catgut was asked to coöperate in our experimental investigations, and furnished us with the finest sized chromic catgut possible, affixed to appropriate sized atraumatic needles. The work described was started in April, 1937. So far as we have been able to determine, the technique employed in gastric resections and the comparative studies of the reactions of the tissues to the coarse and fine catgut have never before been done, nor have the experiments described in Series VI and VII of this paper.

METHODS AND MATERIALS

The dog was selected for the experiments because its stomach closely resembles that of man in size, shape and blood supply. While the total hydrochloric acid secreted in the dog's stomach is proportionately greater than in that of man, we concluded that any detrimental effect on the results could be discounted since both sizes of catgut would be exposed to the same degree of acidity.

Except in Series VI and VII, adult dogs weighing an average of 10 kg. were used. Food was withheld for twenty-four hours; at operation the abdomen was shaved and painted with 3.5 per cent tincture of iodine. An aseptic technique similar to that followed in operations on man was used. Under ether anesthesia, a vertical mid-epigastric incision was made, the stomach delivered, rubber faced clamps applied and the stomach divided vertically in the pars media. The blood supply was disturbed as little as possible, only small vessels being ligated.

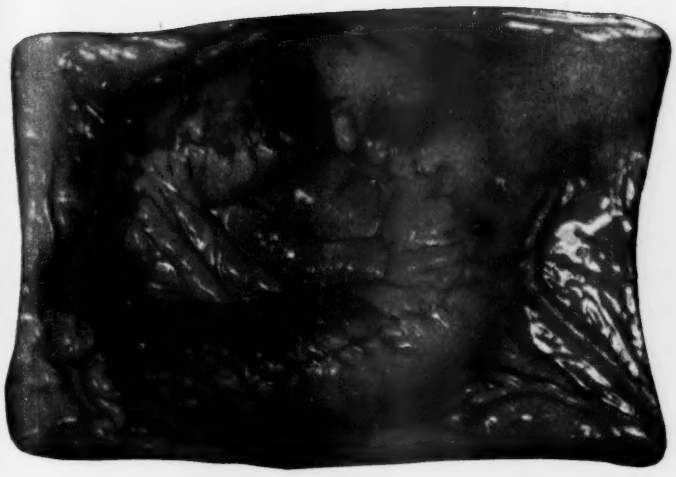
In an attempt to determine the best method of suturing the mucous membrane, continuous sutures of the running type, over and over, and those placed so as to evert the mucous membrane, were used. In several instances in the anterior wall of the stomach the mucosa was approximated with a single continuous over and over stitch and the posterior wall with the Connell stitch. In our early series, we used three rows of continuous sutures in approximately 23 per cent of the operations; later, however, we used two rows, one to suture the serosa and one the mucous membrane. The abdominal wall was closed in layers with continuous silk sutures in the peritoneum, muscle, fascia and skin; the skin was painted with tincture of benzoin. The dogs were given water as soon as they reacted from the anesthetic and soft food at the end of thirty-six to forty-eight hours.

In studying the cross sections prepared for microscopic comparison, the tissue reactions to the different sizes of catgut in the

† Davis & Geck, Inc.

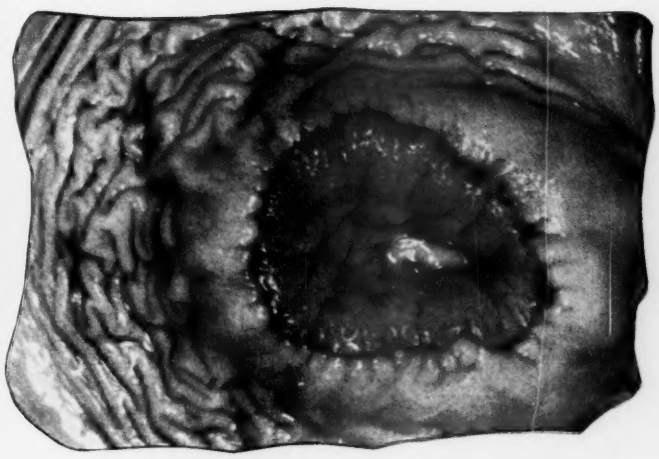
* From the Department of Surgical Research, Temple University School of Medicine and Philadelphia General Hospital.

PLATE I



A

B



C

D

Gross specimens of adult dogs' stomachs, sutured following vertical division with 5-0 chromic and 0 chromic catgut. Continuous over-and-over sutures removed at the end of twenty-four and 120 hours.

A, twenty-four hours. 5-0 chromic. The edges of the mucous membrane were uniformly apposed. Because of the minimal necrosis of cells, the catgut, including the knot, was not exposed and edema was slight. The irregular discolored areas 0.5 to 1 cm. distant from the suture line were the result of operative trauma. These submucous capillary hemorrhages were usually absorbed within forty-eight hours.

B, twenty-four hours. 0 chromic. The edges of the mucous membrane were not uniformly apposed. The trauma associated with the passage of the large sized needle and catgut was responsible for cellular necrosis which, in turn, was responsible for the exposure of the catgut strand including the knot. Edema and ecchymosis were marked.

C, 120 hours. 5-0 chromic. Accurate primary apposition of mucosal edges; minimal destruction and subsequent absence of necrosis of cells and less tissue reaction account for the lack of scar tissue at the site of the incision.

D, 120 hours. 0 chromic. The necrosis of the cells in the mucosal edges followed by the exposure of the catgut strand and maximal tissue reaction account for the greater scar formation at the site of incision of the divided mucous membrane.*

* The use of a hand lens will enable the reader to see details more clearly and reveal the third dimension in the photographs.

stomach and intestine were found to be constant in the submucosa and the tissues beneath. In attempting to study the reaction of the cells in the mucous membrane, however, the cross sections were found to be unsatisfactory. It was evident, therefore, that the specimens would have to be prepared by a different method, one which would show these reactions. This was accomplished by using a modified Spalteholz technique. Sections of dogs' stomachs and intestines were rendered

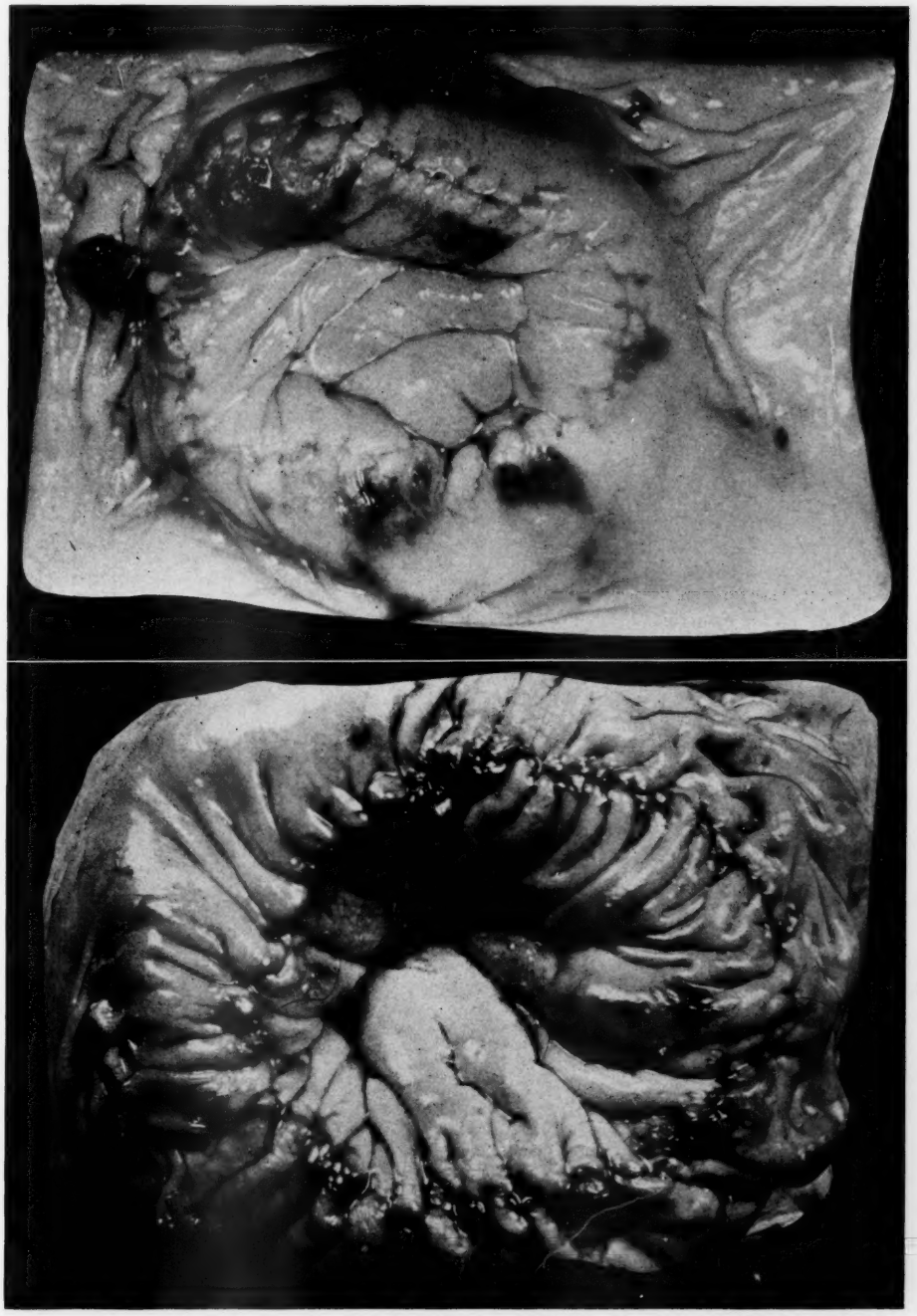


Fig. 1. Twenty-four hours. A, 5-0 chromic—note slight degree of ecchymosis in the mucosa. Very slight edema close to the suture line; mucosal edges were invariably perfectly cemented together; necrosis minimal. B, 0 chromic—edge of mucosa ragged and necrotic; edema marked. Note partial exposure of suture line and untied knot. (See Plate 1, A and B.)

transparent after varying periods of time, following suture of the divided mucosa and serous layers.

needles of suitable sizes; and for some of the clinical investigations, small half-circle atraumatic needles were used.

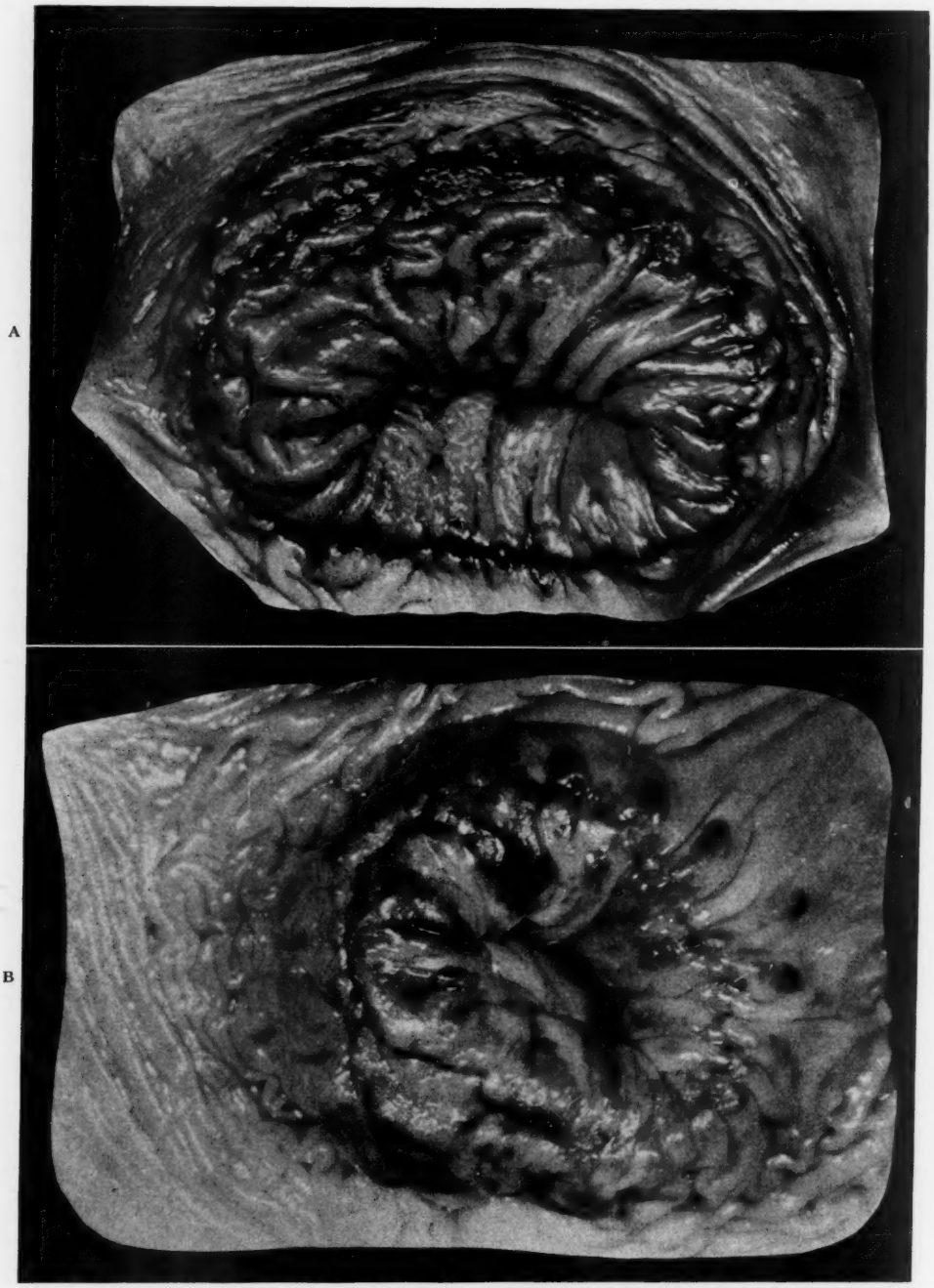


FIG. 2. Forty-eight hours. A, 5-0 chromic—beginning absorption of ecchymotic area; apposition of edges uniform; catgut not exposed. B, 0 chromic—ecchymosis and inflammatory edema slightly diminished; mucous membrane necrotic and covered with puroplastic exudate; note exposure of catgut.

Suture material comprised chromic catgut, sizes 0 and 5-0; and iodized catgut in corresponding sizes. The sutures were affixed to straight, taper point atraumatic

EXPERIMENTAL INVESTIGATIONS

SERIES I

Five pairs of dogs were operated upon. No. 0 chromic catgut was used to anasto-

mose one divided stomach, 5-0 chromic the other of each pair. The entire suture line with approximately 3 cm. of contiguous

No. 1 or No. 11, with Polya modification, was used to close the stomach.

At the time of removal, each specimen

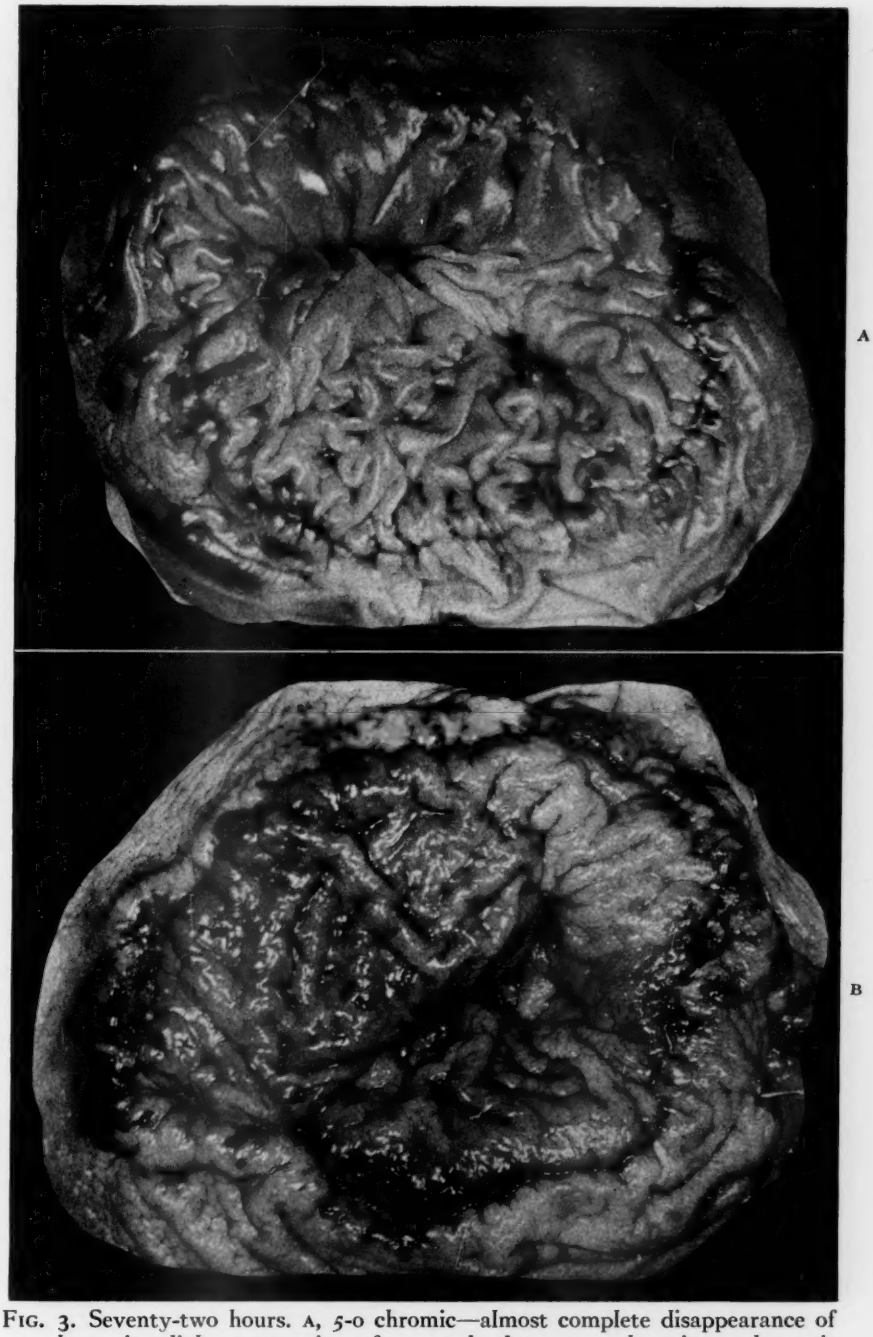


Fig. 3. Seventy-two hours. A, 5-0 chromic—almost complete disappearance of ecchymosis; slight contraction of mucosal edges. B, 0 chromic—ecchymosis diminished; edema same as in forty-eight hour group. Necrosis increased; note exposure of catgut.

gastric wall on either side was removed in each case at a secondary operation, one pair at twenty-four, one at forty-eight, seventy-two, ninety-six and 120 hours. A Billroth was placed so as to avoid tension in a position showing the suture line and a color photograph taken. It was placed in water for twelve hours, then in Kaiserling No. 1

solution for twenty-four hours, after which it was mounted and permanently placed in Kaiserling No. 2 solution.

twenty-four, forty-eight and seventy-two hour pairs, varying amounts of free serosanguinous fluid were encountered; in the

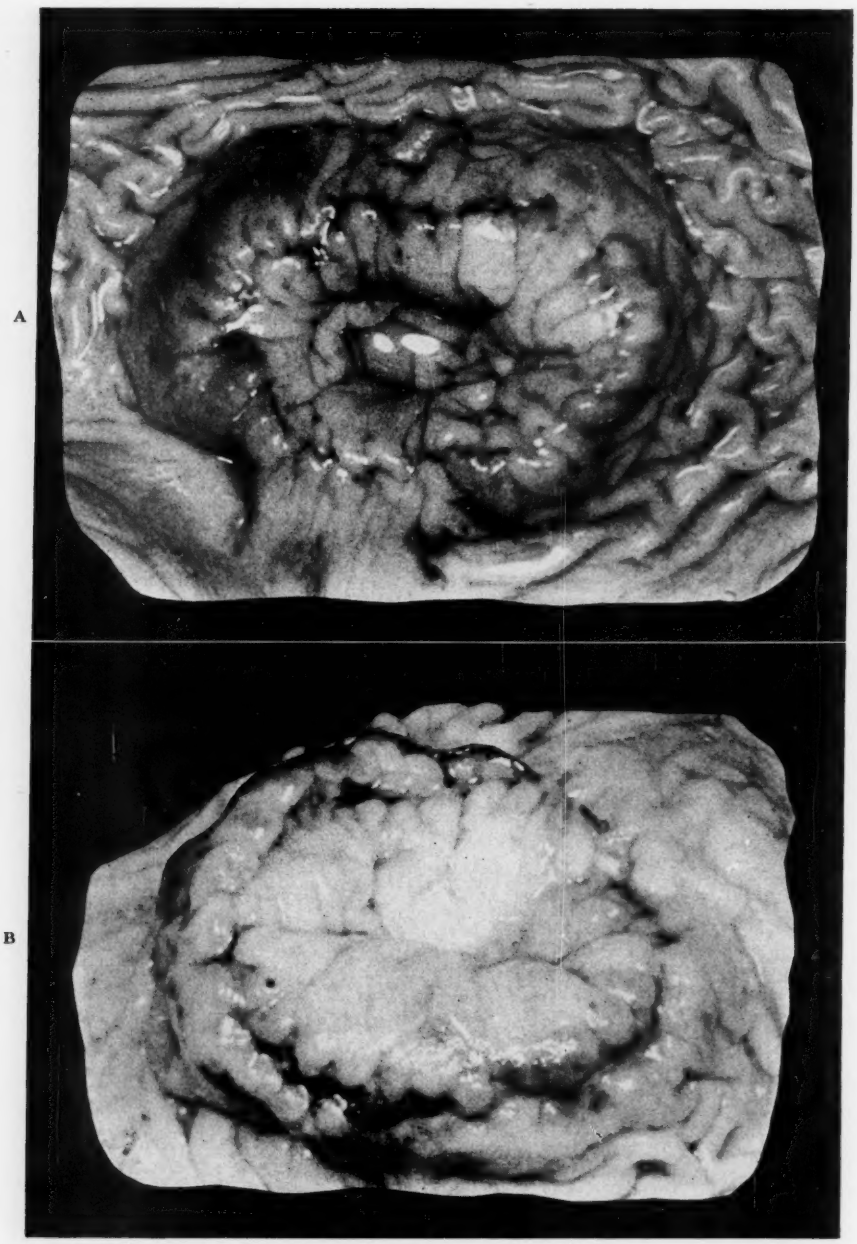


FIG. 4. Ninety-six hours. A, 5-0 chromic—complete disappearance of ecchymosis; further contraction of mucosal edges. B, 0 chromic—note exposed catgut and necrosis of mucosal edges.

Gross Appearance of Gastric Specimens. Without exception, reoperations at the end of twenty-four hours showed the sutured serous coats covered with plastic lymph; usually the omentum and less frequently the small intestine were cemented over the suture line on the anterior surface. In the

ninety-six and 120 hour pairs this fluid was usually not present. Unless great care was taken in separating the omentum and intestine to deliver the stomach for resection, the anastomosis was frequently disrupted where 0 chromic was used, particularly in the seventy-two and ninety-six

hour dogs. Microscopic inspection of the catgut and tissue changes readily explains this, the larger size catgut disintegrating after seventy-two hours. Necrosis of the cells of the mucous membrane contiguous to the catgut was complete at 120 hours. The 5-0 chromic, however, was practically unaffected and little or no necrosis occurred in the surrounding tissues. (Figs. 1–5.)

Summary of Gross Changes of Suture of Mucosa, Submucosa and Serosa of the Stomach of the Dog Following Vertical Bisection, Using 5-0 Chromic and 0 Chromic Catgut. The gross mucosal changes in the

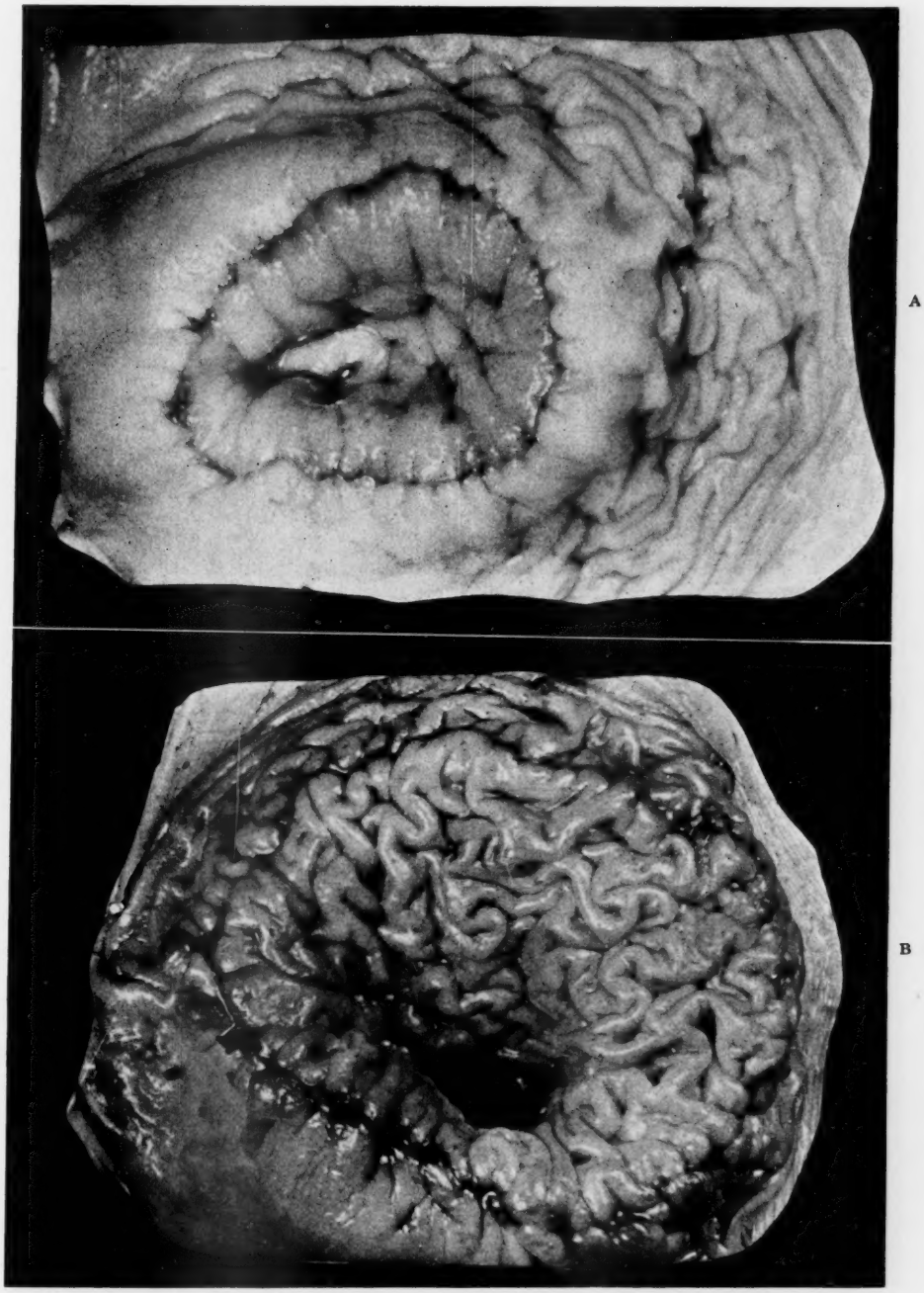
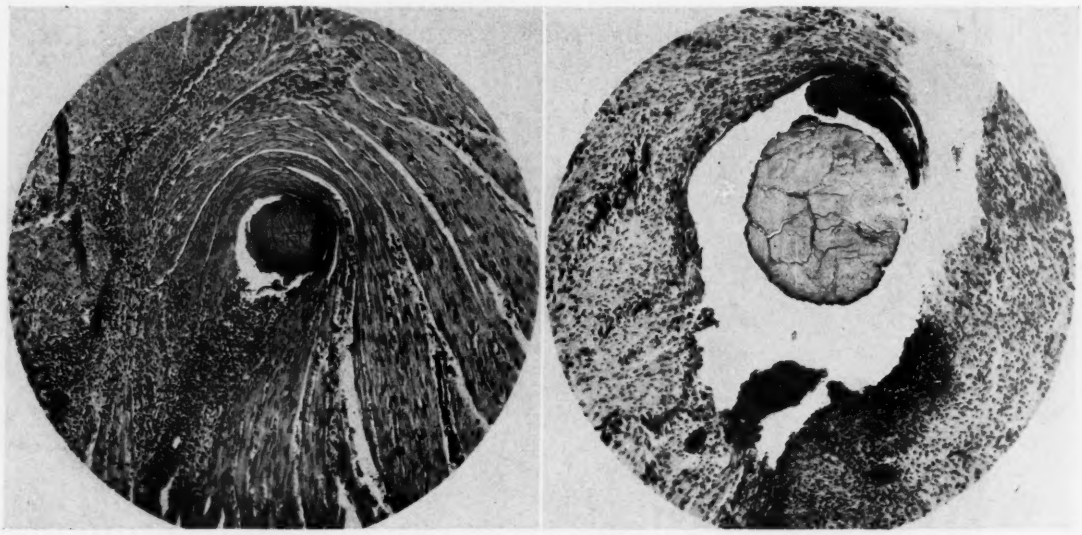


FIG. 5. One hundred and twenty hours. A, 5-0 chromic—accurate complete mucosal union. B, 0 chromic—union of mucous membrane incomplete in certain areas. Where complete, line of apposition distinctly wider than that following suture with the finer catgut. (See Plate 1, C and D.)

specimens sutured with 5-0 chromic catgut showed immediate accurate primary union and a strong anastomotic line due to the absence of necrosis. The gross mucosal changes in the specimens sutured with 0 chromic showed early necrosis of mucosal edges extending over a period of seventy-two to ninety-six hours, exposure of the catgut strand, frequent untying of the catgut knot, and a minimum of accurate primary union. (Plate I.)



A B

FIG. 6. Twenty-four hours. A, 5-0 chromic—mucosal openings small due to fine caliber of needle and minimum trauma associated with the drawing through of the catgut strand. Catgut is intact and leucocytic infiltration slight. B, 0 chromic—mucosal openings large due to the passage of a large caliber needle; marked trauma induced by the drawing through of the catgut strand. Catgut intact; marked leucocytic infiltration.

SERIES II

Another five pairs of dogs were selected and the identical technique and operation of Series I carried out. The anastomosis with contiguous gastric mucosa was removed, as in the first series, one pair at each twenty-four-hour interval to 120 hours. After being photographed, they were placed in 10 per cent formalin and then prepared for microscopic examination. The paraffin technique was used and the sections stained with hematoxylin-eosin. An average of four to six sections were made from each anastomosis and, after being studied, those showing the maximum absorption of catgut were selected for photomicrographs.

Figures 6 to 11 show the cross sections of tissue and catgut strand 5-0 chromic and 0 chromic. They demonstrate very clearly the wide difference in absorption and tissue reaction between the two sizes of catgut.

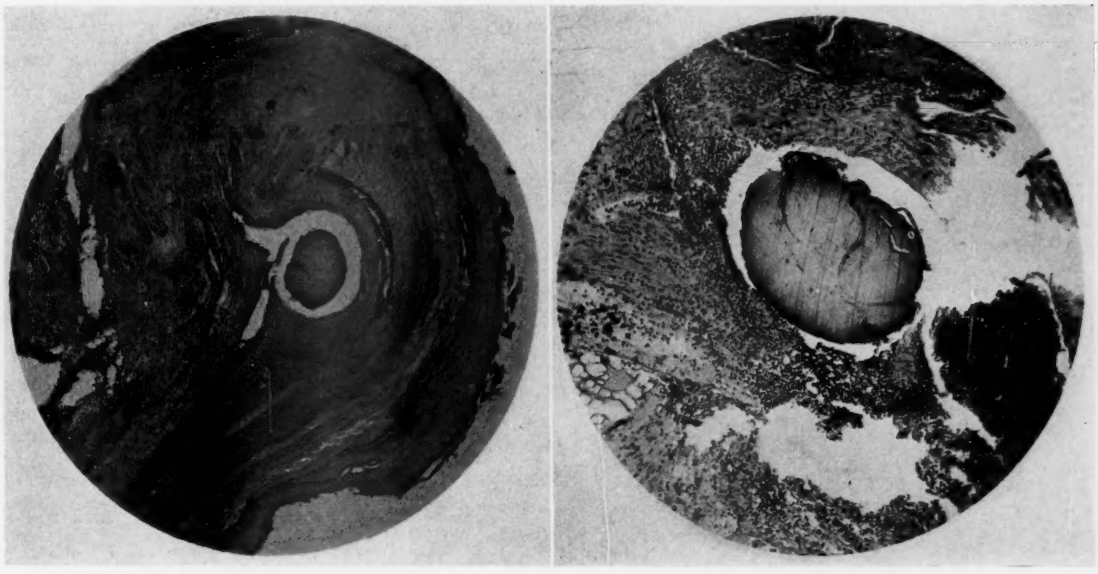
Summary of Microscopic Changes. 5-0 Chromic. Minimal destruction of cells because of fine caliber of needle and catgut; minimal tissue irritation shown by almost complete absence of leukocytic infiltration; prolonged retention of catgut in the tissues.

0 Chromic. Maximum destruction of cells due to large caliber of needle and the drawing through of a large catgut strand; early absorption of catgut beginning at the end of seventy-two hours, more marked at the end of ninety-six hours and almost complete at the end of 120 hours. Leucocytic infiltration of the tissues accompanying absorption increased commensurately, reaching its maximum on the fifth day.

SERIES III

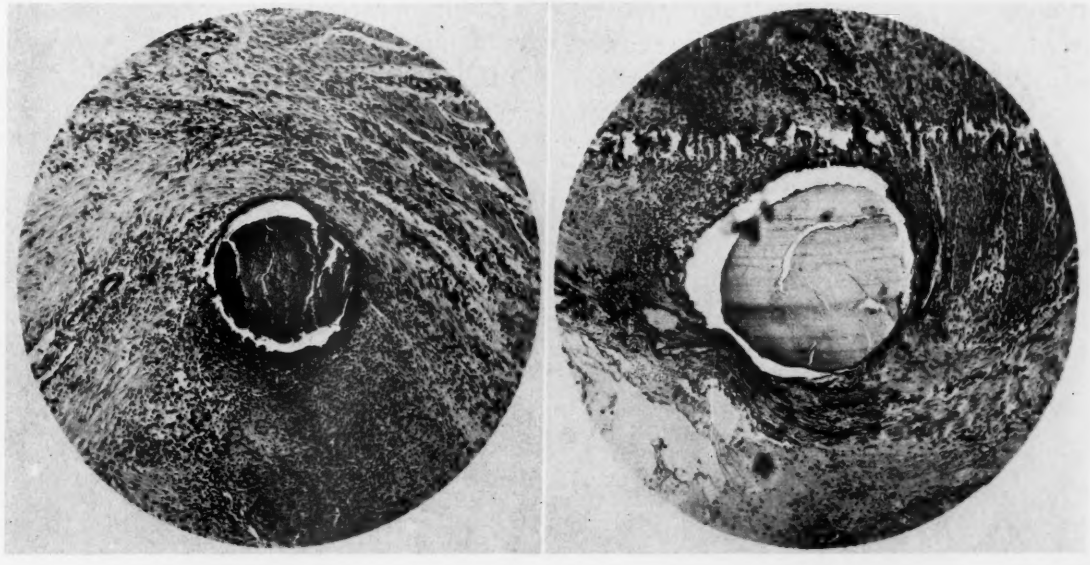
Gastroduodenostomies were performed on five pairs of dogs, using 5-0 chromicized and 0 iodized catgut. The serosa, muscularis and the mucosa were approximated with two rows of sutures; accurate apposition

was difficult because of the friability of the mucosa of the dog's duodenum. The preparation of the animals, operative technique, photographs of specimens, sections of tissue and preservation of specimens were identical with Series II. Specimens were removed at the end of twenty-four, forty-eight, seventy-two, ninety-six and 120 hours.



A B

Fig. 7. Forty-eight hours. A, 5-0 chromic—catgut intact; leucocytic infiltration slight. B, 0 chromic—catgut intact; leucocytic infiltration increased over twenty-four hour section.



A B

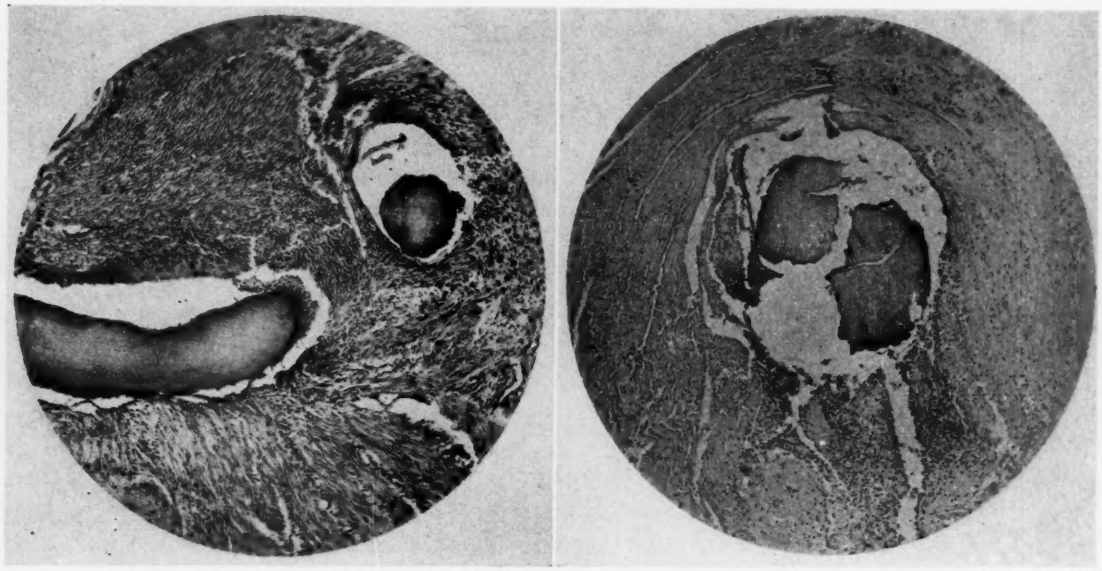
Fig. 8. Seventy-two hours. A, 5-0 chromic—catgut intact; leucocytic infiltration very slight. B, 0 chromic—cross section of catgut showed beginning disruption; leucocytic infiltration markedly increased.

5-0 *Chromicized.* The gross changes were identical with those observed in Series I.

0 *Iodized.* Early necrosis of the mucous membrane, exposure of the catgut strand, persistence of inflammatory reaction involving the mucous membrane approximately 1 cm. distant from the imperfectly united edge, and more marked retraction

of the anastomotic line, were the constant changes accompanying this series.

Summary of Gross Tissue Changes. Minimal mucosal necrosis and inflammatory reaction resulted in immediate, accurate union of the apposed mucosal edges where 5-0 chromic was used. 0 iodized, on the contrary, showed gross changes similar to and frequently more marked than those observed in the anastomotic line in the stomach where 0 chromic was used, i.e., early mucosal necrosis, exposure of the catgut strand, inflammatory edema and retracted anastomotic line.



A B

FIG. 9. Ninety-six hours. A, 5-0 chromic—catgut intact; leucocytic infiltration minimal; longitudinal section of catgut showed absence of absorption and minimal tissue infiltration. B, 0 chromic—cross section of catgut showed marked absorption and increased leucocytic infiltration.

SERIES IV

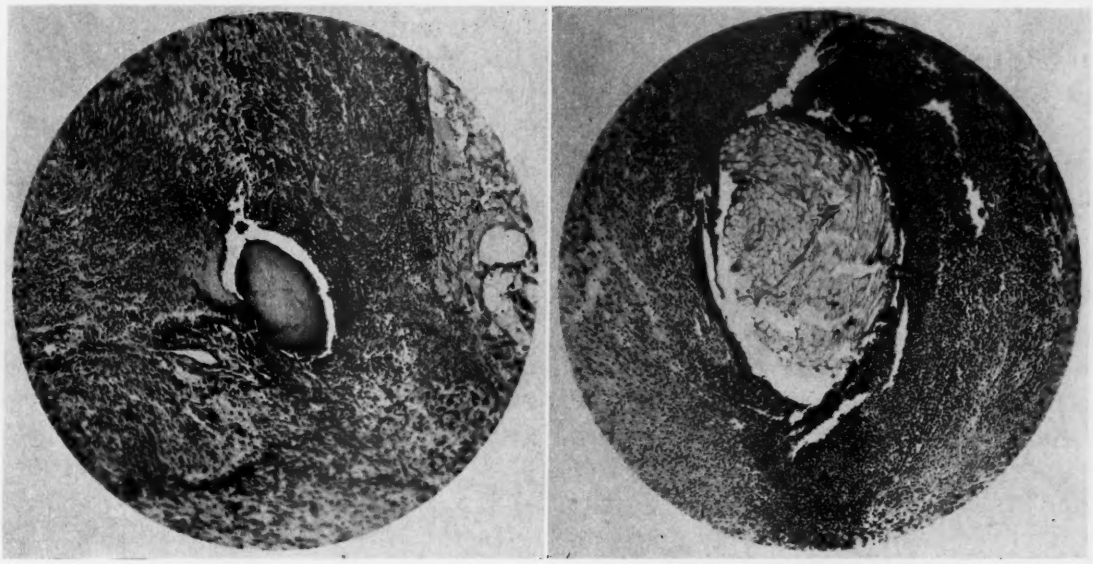
Five groups of three dogs were prepared as in Series I, II, and III and operated on. Three longitudinal incisions, 7 cm. in length were made in the duodenum between rubber covered clamps, opposite the mesenteric border. Approximately 3 cm. of normal intestine separated the incisions. In each group of three, the serosa, the muscularis, and the mucosa of the first dog were sutured with 5-0 chromic; the second with 0 chromic; and the third with 5-0 iodized catgut. At twenty-four-hour intervals, as in the previous series, specimens were removed and prepared by a modified Spalteholz method, a brief description of which follows:

Chest opened and a cannula ligated into aorta, immediately after death of animals by intrathoracic injections of ether. Vascular channels flushed with saline, then injected with a suspension of barium sulfate colored with ammoniated carmine. Portions of gastrointestinal system containing suture lines removed and fixed in formalin. Trimmed to size, washed thoroughly; bleached by immersion in weak peroxide solution, washed again; gradual but complete dehydration with graded alcohols including two changes by absolute alcohol. Specimen cleared by immersion in chemically pure benzine and pure benzyl benzoate. Preservative or mounting fluid is synthetic oil of wintergreen.

5-0 *chromic* showed minimal evidences of operative trauma, little or no ecchymosis, immediate serosal and mucosal union and maximum outbudding of capillaries throughout the suture series.

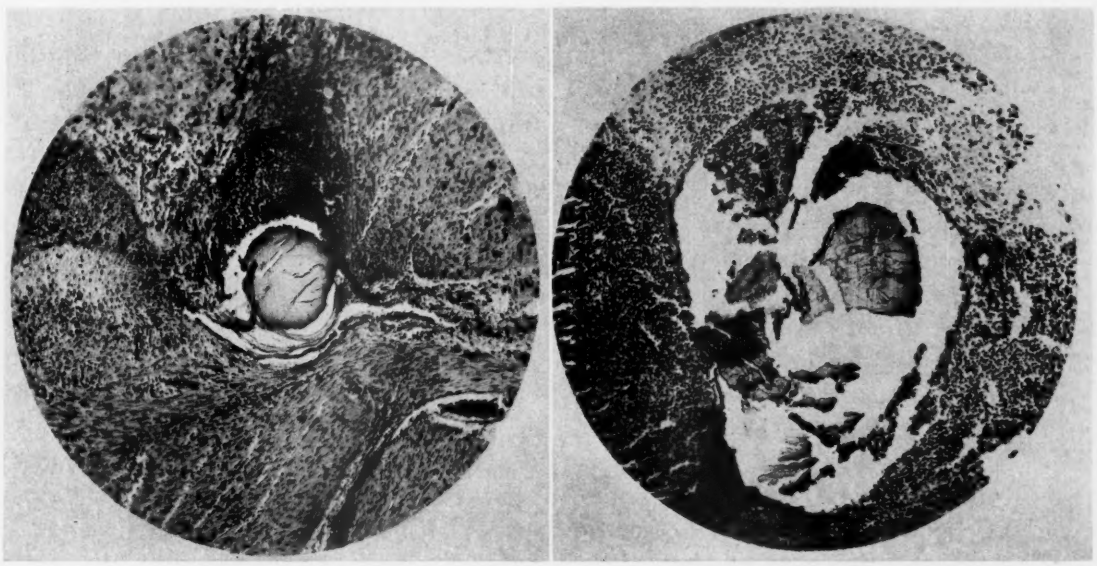
0 *chromic* showed marked evidence of mucosal trauma in the twenty-four to seventy-two-hour specimens with delayed mucosal union, and a minimal outbudding of capillaries in the ninety-six and 120-hour groups.

5-0 *Iodized.* This catgut strand was disrupted almost immediately, at least as early as twenty-four hours, in the mucosa of the duodenum. All specimens in the series, except the twenty-four-hour, showed complete disruption of the mucosa and partial disruption of the serosa.



A B

FIG. 10. One hundred and twenty hours. A, 5-0 chromic—catgut intact with minimal tissue reaction. B, 0 chromic—catgut almost completely absorbed; leucocytic infiltration maximal.



A B

FIG. 11. End of healing period. A, 5-0 chromic—catgut strand intact; slight round cell infiltration. B, 0 chromic—marked disruption of catgut and extensive round cell infiltration.

Summary of the Gross Tissue Changes. Transparent specimens of suture of a longitudinal incision in the duodenum with 5-0 chromic, 0 chromic, and 5-0 iodized catgut demonstrate that 5-0 chromic catgut produces minimal tissue irritation; that capillary proliferation occurs early resulting in rapid accurate union; that 0 chromic catgut produces marked tissue irritation and slow union of the mucosal surface and that in those specimens where 5-0 iodized catgut

was used, the mucosa in most instances was completely and the serosa partially disrupted.

SERIES V

In five pairs of dogs prepared as in Series I, II, and III, a 5 cm. midhorizontal incision was made in the stomach on the anterior wall, between rubber covered clamps. In each pair the mucosa and seromuscular layer of one dog were sutured with 5-0 chromic continuous catgut; in the other 0 chromic was used. The entire stomach of each dog was removed; one pair at twenty-four, one at forty-eight, seventy-two, ninety-six and 120 hours after the first operation. These specimens were also prepared by the modified Spalteholz method. The stomachs were large and the difficulty of obtaining uniform clearing made it advisable to remove sections of the suture line with contiguous tissue and mount them for comparison.

5-0 *Chromic.* Transparent specimens of the twenty-four to 120-hour groups inclusive showed that the strand used to unite the serosa remained intact throughout. healing was undelayed due to absence of capillary hemorrhage. The 5-0 chromic catgut strand in the mucosa remained intact for ninety-six hours—the twenty-four and forty-eight-hour specimens showed minimal capillary hemorrhage. The forty-eight-hour specimen, however, showed slight mucosal separation, due to the stretching of the specimen as the catgut strand remained intact with no evidence of ecchymosis. The suture line, however, remained intact. The seventy-two-hour specimen showed beginning capillary extension or budding at the mucosal edges; in the ninety-six-hour specimen the budding had advanced perceptibly. (Plate IIC.)

0 *Chromic.* Serosal sutures remained intact throughout the series, twenty-four to 120 hours, similar to 5-0 chromic. The mucosal sutures, however, showed absorption taking place more readily than 5-0 chromic, disappearing in the mucous membrane at the end of seventy-two hours. After ninety-six hours, only the incompletely tied knot of catgut at one end of the anastomotic line remained intact. (Plate IID.) All specimens showed a minimal degree of capillary budding.

Summary of Gross Changes. The transparent specimens present absolute evidence corroborating the conclusions we had reached after microscopic study of the cross sections of catgut; that the finer catgut, 5-0 chromic, remains longer and produces less irritation than the larger, 0 chromic. Capillary budding extends toward and over the anastomotic edge earlier in the 5-0 group, accounting for the solidity of union of the divided mucosa in these groups.

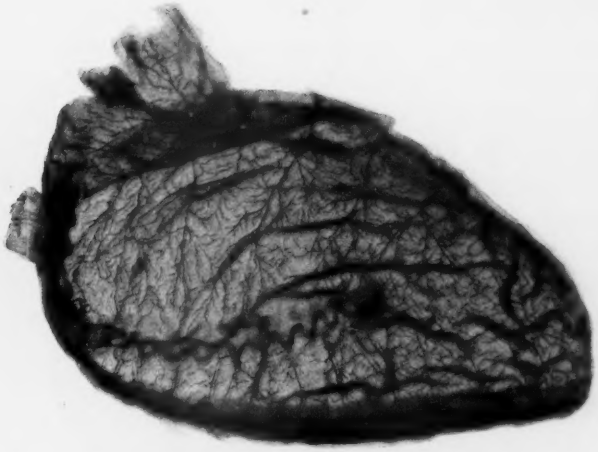
SERIES VI

In the entire study to this point, adult dogs had been used. In order to determine the tissue reaction in young animals and also with the hope of obtaining satisfactory specimens of the entire stomach, we selected six weeks old puppies for the sixth series. Five pairs of puppies were prepared and operated upon, using the same technique as in Series V. A horizontal incision 7 cm. in length was made through the anterior wall of the stomach, and the seromuscular and mucosal layers were sutured with 5-0 chromic and 0 chromic catgut. The modified Spalteholz method was again used in preparing the specimens. The puppies withstood the operative procedure surprisingly well. Specimens were removed at twenty-four, forty-eight, seventy-two, ninety-six and 120 hours after the first operation.

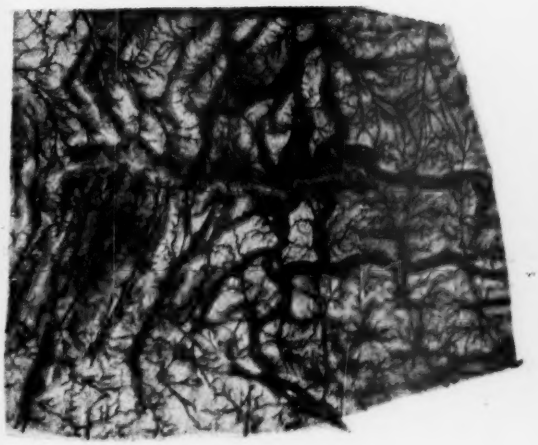
5-0 *Chromic.* The twenty-four to seventy-two-hour specimens showed minimal or complete absence of extravasation of blood into the mucosal, submucosal and muscular layers of the stomach. In the twenty-four hour specimens a slight brown discoloration on either side of the suture line evidenced slight hemorrhagic extravasation; but in the forty-eight and seventy-two-hour specimens it was completely absorbed and careful inspection

PLATE II

A



B



C

D

Gross specimens of young and adult dogs' stomachs showing the results of our attempts to obtain better union of the divided mucous membrane, using 5-0 chromic catgut. 0 chromic was used in the control groups.

A, gastric mucosa of young dog united with 5-0 chromic catgut, continuous over-and-over suture. Removed ninety-six hours after operation. Because of the very small caliber of the needle and catgut, a minimal number of mucosal cells was destroyed; intracellular extravasation of blood and necrosis with polymorphonuclear infiltration slight. The catgut strand remained intact and the minimal cellular reaction induced is evidenced by the fact that capillaries can be observed approaching, and in some instances actually inosculating with, those across the united mucosa.

B, gastric mucosa of young dog sutured with 0 chromic catgut, continuous suture. Removed ninety-six hours after operation. Because of the comparatively large caliber of the needle and catgut, excessive destruction of cells occurred; this was accompanied by intracellular extravasation of blood followed by necrosis and polymorphonuclear infiltration. The apposed mucosa was completely absorbed and the catgut strand has almost entirely disappeared—there is no evidence of capillary budding.

The 5-0 chromic specimens in the twenty-four, forty-eight and seventy-two hour groups show early absorption of blood and beginning capillary budding at the end of forty-eight hours. In the 0 chromic specimens the apposed mucosal cells were viable at the end of twenty-four hours, but the excessive amount of blood interfered with the capillary budding and the disruption of the catgut strand began between forty-eight and seventy-two hours.

C, divided gastric mucosa and serosa of adult dog sutured with 5-0 chromic catgut. Removed at the end of ninety-six hours. Changes identical with A. Mucosa united; catgut intact.

D, divided gastric mucosa and serosa of adult dog united with continuous sutures of 0 chromic catgut, removed at the end of ninety-six hours. Mucous membrane did not unite—the edges separated approximately 5 mm.; the catgut was absorbed except the knot at left end of suture line; necrosis of the mucosal edges was complete.

In all four specimens it will be observed that the sutures in the serosa are intact. Because of the slight difference in the points of focus of the mucosal and serosal sutures, the photographer was unable to exclude them.*

* The use of a hand lens in viewing these photographs will aid the reader to see the details more clearly.

with a magnifying glass showed the catgut strand to be unaffected throughout. The ninety-six and 120-hour specimens in this series, along with those of the adult dogs' stomachs, are outstanding among the transparent specimens. They demonstrate the fact (which we were unable to show microscopically) that *5-0 chromic catgut remains in the mucosa longer and produces less irritation than 0 chromic.* Furthermore, capillary proliferation or budding occurs at its maximum rate, the ends of these vessels on either side of the divided mucosa inosculating frequently. This phenomenon was still more noticeable on the fifth day. (Plate IIA.)

0 *Chromic.* The twenty-four and forty-eight-hour specimens showed marked evidence of extravasation of blood into the mucosal, submucosal and muscular coats of the stomach; in the seventy-two-hour specimen this was absorbed to some degree, but that it had interfered with the capillary budding was shown by the more pronounced translucent area and at no point did the capillaries cross the line where the apposing edges of mucous membrane were held together. Budding of capillaries, however, had taken place in the 120-hour specimens. (Plate IIB.)

Summary of Gross Changes. Inspection of the transparent specimens of puppies' stomachs with the aid of a simple magnifying glass confirms what was found in the transparent specimens of adult dogs' stomachs. 5-0 chromic remains longer and is less irritating to the tissues of the stomach. Union of the divided mucous membrane occurs in minimum time as shown by the capillary budding. Inspection of the serosa shows that the catgut strand remains unabsorbed when both fine and coarse strands are used; but only the 5-0 chromic remains intact in the mucosa for ninety-six hours—the 0 chromic being disrupted and partially absorbed. (Plate IIA and B.)

SERIES VII

Young dogs were also used in this series to demonstrate the comparative rate of absorption and tissue reaction of 5-0 chromic and 0 chromic in the tissues of the anterior abdominal wall. A vertical 7 cm. incision was made through the middle of the right rectus abdominis muscle; and the peritoneum, muscle and deep fascia sutured. Five pairs of puppies were used, their tissues being sutured, one of each pair with 5-0 chromic and the other with 0 chromic. Sections of the entire suture line including the tissue 2 cm. on either side were removed, prepared by the Kaiserling method, embedded in paraffin, sectioned and stained with hematoxylin-eosin. From four to six sections of each specimen were studied and the ones showing the maximum absorption of catgut in each case was used for photomicrographs which demonstrate a minimal absorption of catgut and tissue reaction in 5-0 chromic as compared with 0 chromic.

5-0 *Chromic.* Microscopic sections of the entire abdominal wall removed at varying intervals from two to ten days confirm the observations made from the microscopic sections of the stomach. 5-0 chromic catgut remained intact and produced a minimum of tissue irritation. At the end of ten days, the strand was still intact and the tissue around it showed minimal leucocytic infiltration.

0 *chromic,* as in the gastric specimens, began to disintegrate on the third day and increased until the catgut was practically absorbed on the sixth to tenth days. Leucocytic infiltration increased commensurately.

Summary of Microscopic Changes. 5-0 chromic and 0 chromic catgut were used to suture the peritoneum, rectus abdominis muscle and deep fascia of young dogs. Cross sections of tissue removed and studied microscopically at periods varying from two to ten days revealed that the 5-0 chromic strand remained intact longer and produced minimal tissue irritation as compared with the larger 0 chromic catgut strand.

RESULTS

Comparative study of microscopic changes occurring in the muscle, fascia,

and peritoneum of the abdominal wall, and gross changes in the mucous, submucous, muscular, and peritoneal coats of stomachs of young dogs shows that 5-0 chromic catgut produces minimal tissue reaction and maintains integrity longer than 0 chromic catgut.

In the stomach, absorption of 0 chromic catgut begins forty-eight hours after operation; is almost complete in five days, and is attended with maximal neutrophilic mobilization. Integrity of 5-0 chromic catgut is maintained throughout the healing period, and leucocytic infiltration is minimal.

Comparative study of gross tissue changes in the suture lines accompanying gastroduodenostomy, incision and suture of the ileum of young dogs, and incision and suture of the stomach of mature dogs, shows in every instance the superiority of 5-0 chromic catgut. It produces minimal tissue reaction and maintains integrity longer than 0 chromic catgut. The 5-0 iodized catgut and the 0 iodized show early disintegration.

CLINICAL INVESTIGATIONS

The results of our experimental studies were verified by clinical investigations. The practical value of this new fine-size suture of 5-0 chromic catgut was repeatedly demonstrated in surgery of the gastrointestinal system and biliary tract; in suturing the dura, tendons (tenorrhaphies), and nerves (neurorrhaphies); and in the surgery of children. Complete report of clinical results will appear later.

CONCLUSIONS

Our experimental investigations and clinical observations have demonstrated that 5-0 chromic catgut may be used to replace larger sizes of sutures in a variety of surgical situations. Where close and uniform apposition, together with minimal trauma and cellular reaction are essential, it is especially indicated.

The use of 5-0 chromic catgut markedly reduces tissue trauma; produces minimal cellular reaction; insures strong apposition of mucous and serous membranes, because nearly twice as many stitches can be inserted within a given space, thereby providing a suture line of great strength; gradual and uniform absorption insures prolonged retention of the catgut in the tissues, and thereby reduces danger of hemorrhage and peritonitis.

The authors are indebted to Dr. Ralph O. Clock for his many helpful suggestions. They also wish to express their appreciation to Davis & Geck, Inc., of Brooklyn, New York, for their coöperation in developing and perfecting 5-0 chromic catgut with suitable atraumatic needles to meet the special requirements of this research problem; and for their generosity in furnishing an adequate supply of catgut sutures for use in these experimental investigations.

SIMPLIFICATION OF THE PHYSICK-FRANK-SELLHEIM PRINCIPLE OF EXTRAPERITONEAL CESAREAN SECTION*

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NEW YORK CITY

IN Dewees[1] text on midwifery there appeared a letter (as a footnote) dated September 28, 1824 and written by William Edmonds Horner, then Adjunct Professor of Anatomy at the University of Pennsylvania. This letter credited Philip Syng Physick, Professor of Surgery at that institution, with a new principle for a true extraperitoneal cesarean. Horner stated in part that "the peritoneum be stripped from the upper fundus of the bladder by dissecting through the connecting cellular substance." Physick even advised moderate distention of the bladder to facilitate visualization of that viscus and to promote ease of dissection.

This reference passed unnoticed. Indeed, the few efforts at extraperitonealization during the remainder of the nineteenth century—those of Baudelocque,[2] Cianflone,[3] Thomas,[4] Skene,[5] Budin,[6] Hime,[7] Edis,[8] Gillette,[9] Dandridge,[10] Jewett,[11] Poullet,[12] were all of the Ritgen-Baudelocque-Bell type. Singularly enough, of these fourteen operations, six were performed in Brooklyn, New York. Ritgen[13] attempted the first extraperitoneal cesarean (October 12, 1820) by incising parallel to the right Poupart's ligament, from midsymphysis to the crest of the ilium. The "loosely fitting" peritoneum was displaced and the vaginocervical (lower segment) area incised. This technique, an innovation, proved a failure in Ritgen's hands; the severity of the hemorrhage and the patient's collapse interfered with its completion. The procedure was labelled *gastro-elytrotomy* or *laparo-elytrotomy* (Bauch-scheidenschnitt) by Ritgen. Baudelocque wrote his Paris thesis on this subject in 1823 and Charles Bell,[14] Professor of Surgery of Edinburgh, outlined the steps of the operation in his *Institutes of Surgery* (1838). Adequate reviews of this type of cesarean were subsequently written by Garrigues,[15] Masson,[16] McCormack[17] and Clarke.[18]

The first to attempt an extraperitoneal cesarean according to the suggestion credited to Physick was Frank[19] of Cologne in 1907. He pointed out that if the "bladder was high" it was possible to strip the peritoneum from the vault of that viscus. Frank, though successful in the occasional case, met with considerable difficulties in separating the peritoneal fold from the bladder dome. These same difficulties were encountered by Sellheim[20] in the following year (1908) in his numerous efforts to find a true extraperitoneal approach. The principle was completely abandoned when Latzko[21] introduced his method of extraperitonealization by lateral displacement of *both* the bladder and the peritoneal reflection (1909).

The difficulties encountered by Frank and Sellheim were due, primarily, to their persistent attempts at beginning the separation of the peritoneal fold from the bladder wall exactly in midline, which is the maximum point of fusion (urachus) between these two structures. These difficulties, the author has circumvented in a simple way—by combining the Frank-Sellheim method with the Latzko lateral approach. This article is presented merely to outline the simplification of an old principle, thereby rendering that principle surgically applicable and useful. The procedure is not a distinct innovation, but rather a combination of steps (all previously utilized) which facilitates a true extraperitoneal approach to the lower segment, thereby inflicting a minimal amount of surgical injury on the patient and avoiding

* From the Department of Gynecology and Obstetrics, City Hospital.

the hazards of surgical trauma to the bladder. The operation is applicable both to the laboring and non-laboring patient, although, in the latter instance, the dissection must be conducted with greater surgical delicacy and technical skill.

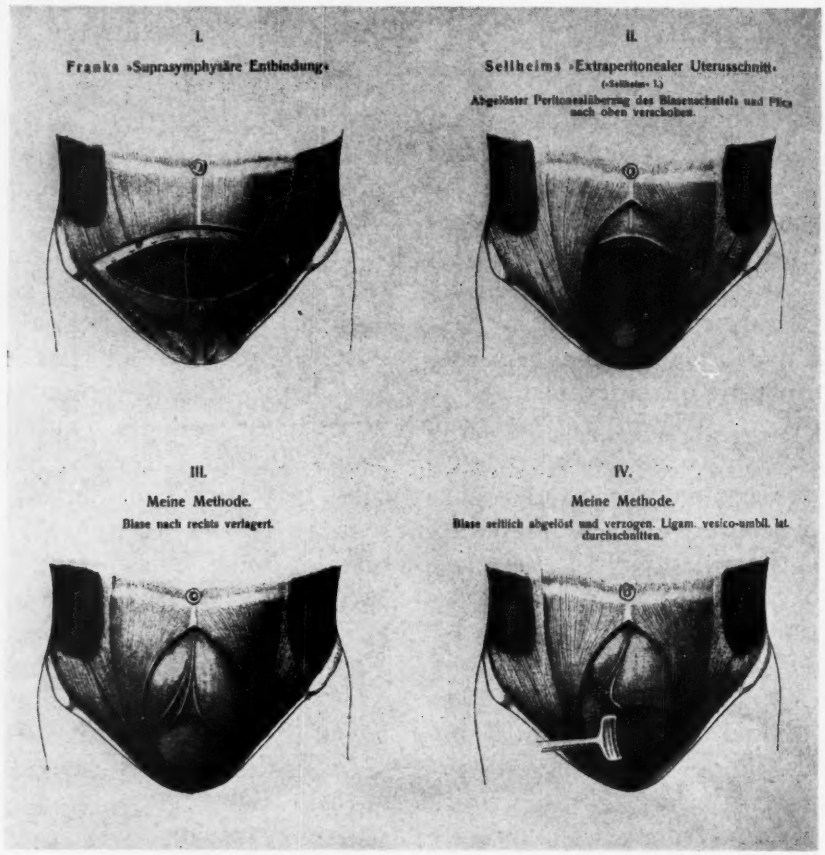

FIG. 1. I, Fritz Frank's peritoneal exclusion operation (1907). II, Hugo Sellheim's extraperitoneal cesarean (1908). III and IV, Wilhelm Latzko's extraperitoneal method (1909). (From *Wien. klin. Wchnschr.*, 1909.)

Technical and Anatomic Considerations. The patient is placed on the operating table with extremities in lithotomy position. After adequate vulval aseptic preparation, the bladder is emptied with a number 16 F. catheter which is inserted for two-thirds its length and left in situ. This measure will delineate the contour of that viscus in a more practical manner than vesicoclysis. The vagina is packed, rather thoroughly, with iodoform gauze, for the purpose of displacing the inferior portion of the lower segment (and the fetal head if needs be) upwards above the symphysis, thus bringing the essential parts squarely into the operating field.

With the completion of these steps, the patient is placed in a moderate Trendelenburg position. A Pfannenstiel incision, 4½ inches long, is made just above the pubic hairline, preferably in the normal skin fold usually found in the suprasymphysial area. With proper retraction and lateral deviation of the recti muscles, the parietal *fascia transversalis* appears in the operating field. *This structure is incised transversely, well over the bladder surface, avoiding that part of the fascia covering the parietal peritoneum; since it (the fascia) serves as a reinforcement of that otherwise exceedingly thin peritoneal membrane.* This is the "key" to the success of the operation. Incision of the fascia covering the parietal peritoneum invariably leads to a break in the contiguity of that membrane. It was this initial error which (in part) accounted for the dissectional difficulties

and the failures encountered by Frank and Sellheim.

It is well to recall that the pregnant woman *at term* presents certain distinctive changes in texture, shape, size and relationship involving the bladder, uterus, peritoneum and fascia. These structures may participate in all of these changes to a variable degree or in only one of them to a total exclusion of the others. And it is these changes in anatomic relationships which render this operation feasible. First, the peritoneum—including that part juxtaposed and adherent to the uterus—though it does not manifest the usual hypertrophies and engorgements of the genitalia, changes its shape and relationship with respect to the bladder and the uterus. Second, the bladder is carried upward, i.e., *cephalad*, by the gravid uterus and it becomes an abdominal rather than a pelvic organ, even in its non-distended state. Third, the parietal *fascia transversalis*, a thin yet dense inelastic membrane, beneath the symphysis, begins its devious extensions to, and reflections over, the pelvic organs and the bladder. That portion of the fascia on the anterior vesicular wall (*fascia vesicae*) loses its fibrous quality and becomes a thin frail covering of a nonsupportive nature. This fascia is *not* adherent to the bladder; the intervening space is padded with a mesh of engorged fatty pellicles—fat which adheres to the bladder. As the *fascia vesicae* approaches the posterior surface of the bladder and the anterior aspect of the

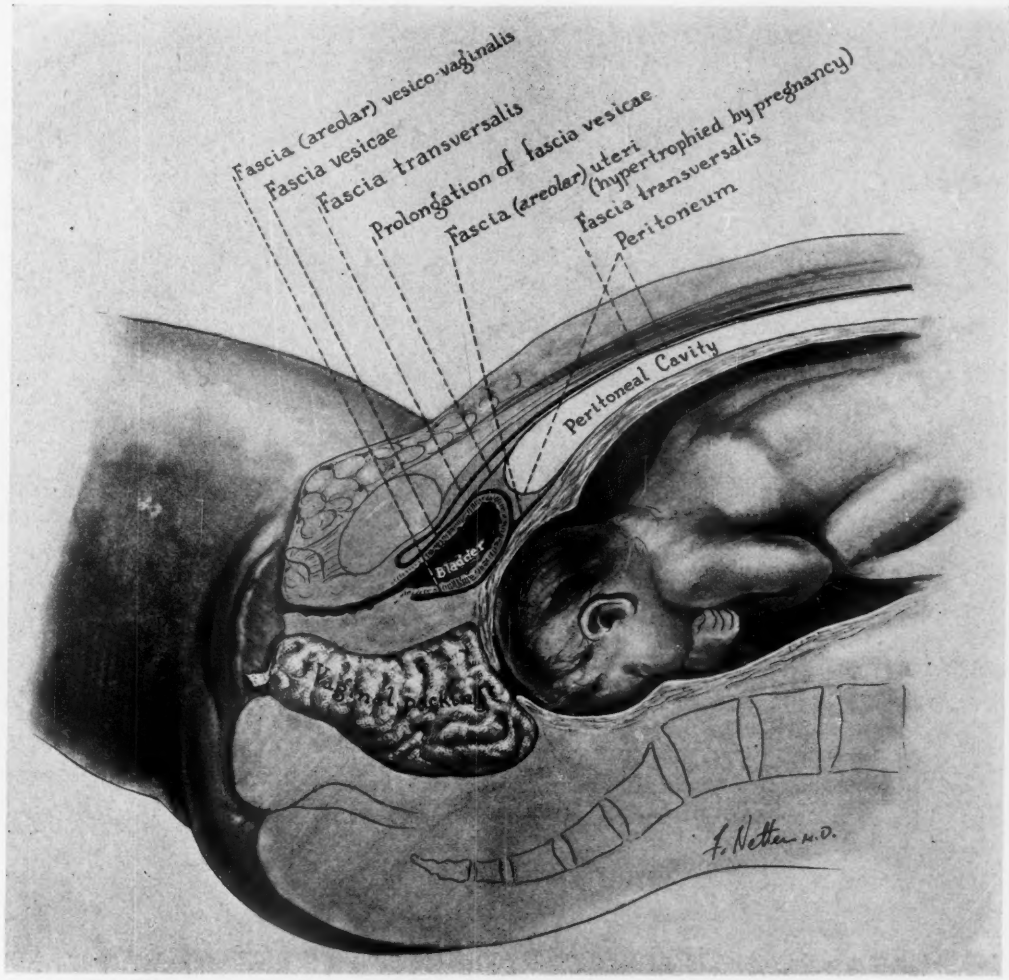

Fig. 2. Semidiagrammatic demonstration of the arrangement of the fascia in relationship to bladder, lower uterine segment, parietal peritoneum and peritoneal fold.

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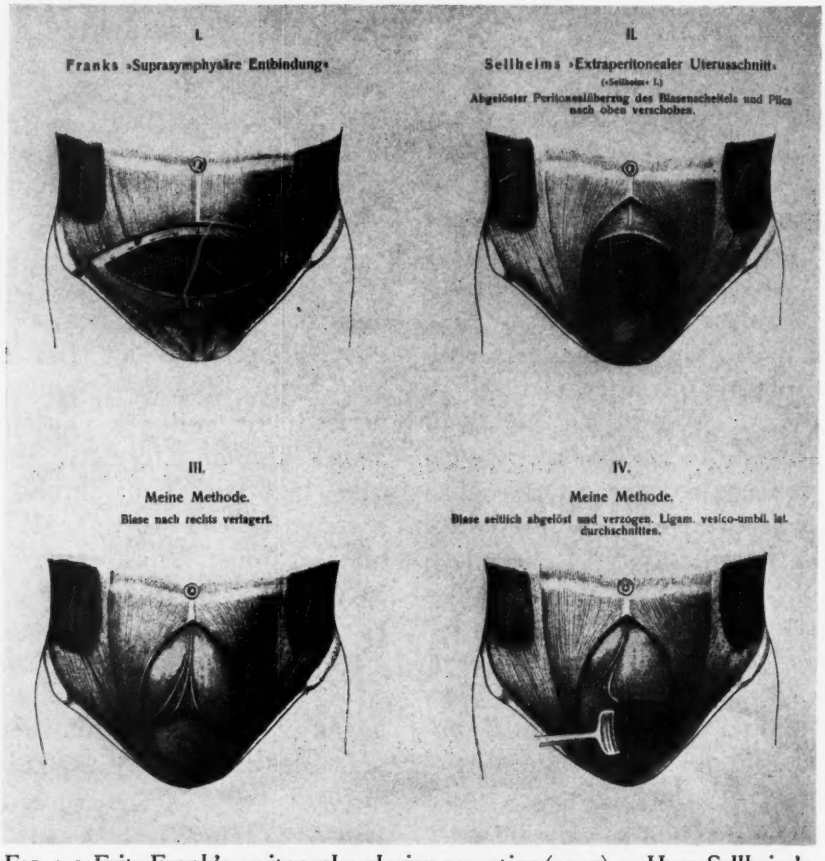

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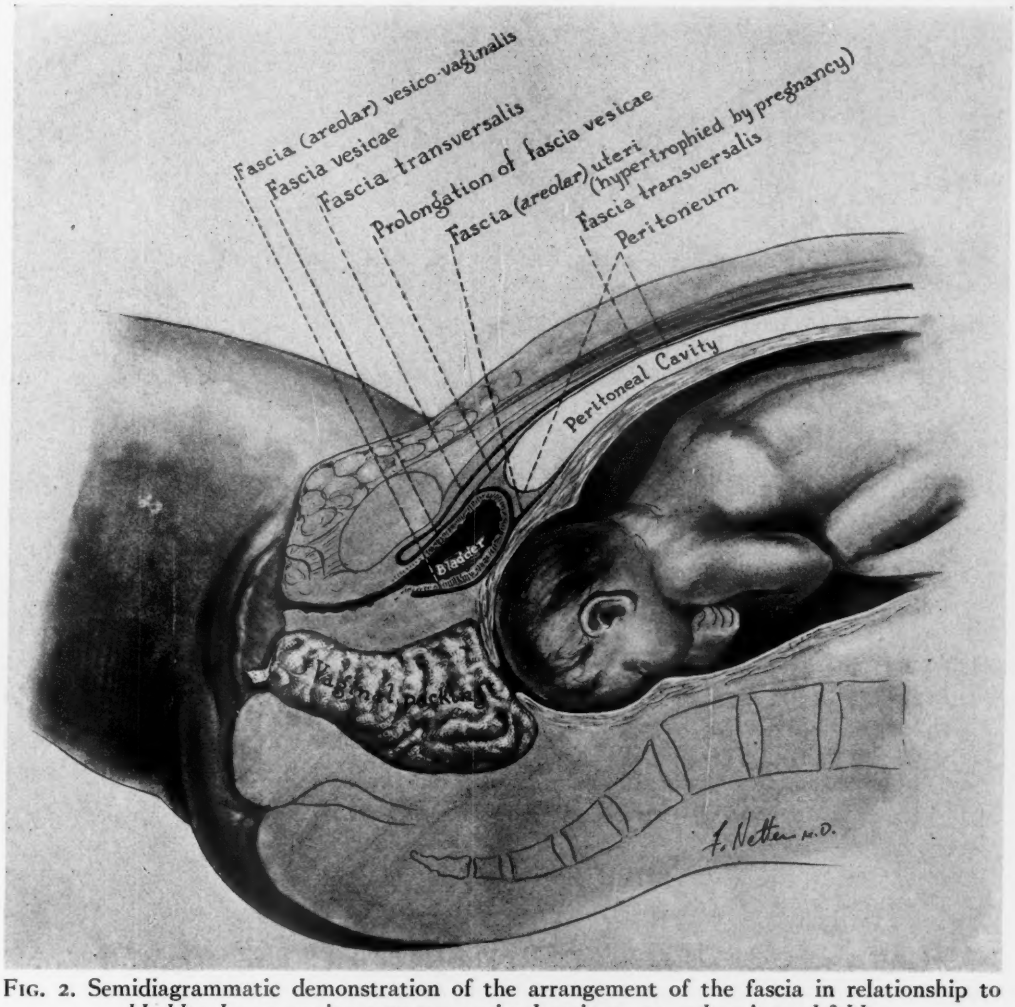

Fig. 2. Semidiagrammatic demonstration of the arrangement of the fascia in relationship to bladder, lower uterine segment, parietal peritoneum and peritoneal fold.

lower segment, it again changes and becomes a loosely knitted fibro-areolar layer markedly hypertrophied, particularly in the terminal stages of the gravid state. This hypertrophy must be considered a buttress of appreciable value to the attenuated musculature of the lower segmental area during the strenuous stages of labor.

It is important to recall that the indiscriminate use of the term "fascia" and the controversial data on its texture and distributions in the pelvis have led to a maze of misunderstanding, and have left

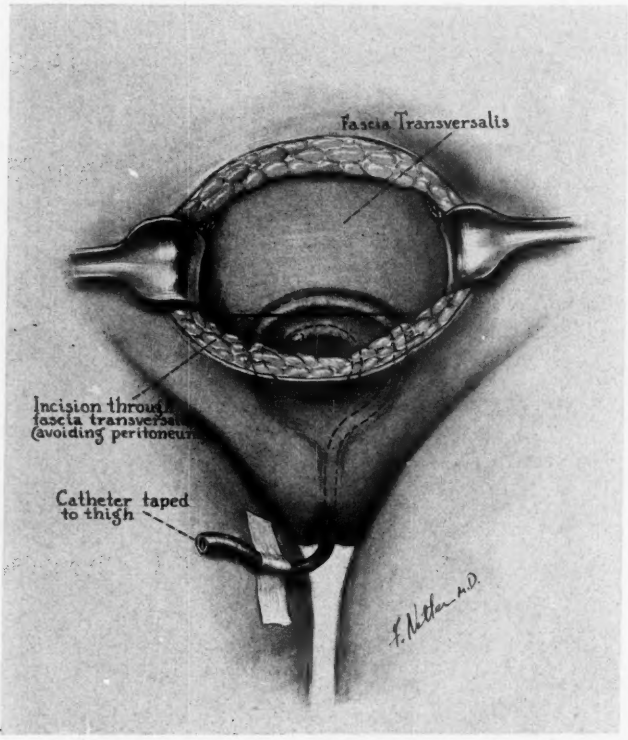

FIG. 3. Pfannenstiel incision, lateral deviation of recti, fascia transversalis, bladder with catheter in situ and incision of fascia transversalis over the upper surface of the bladder.

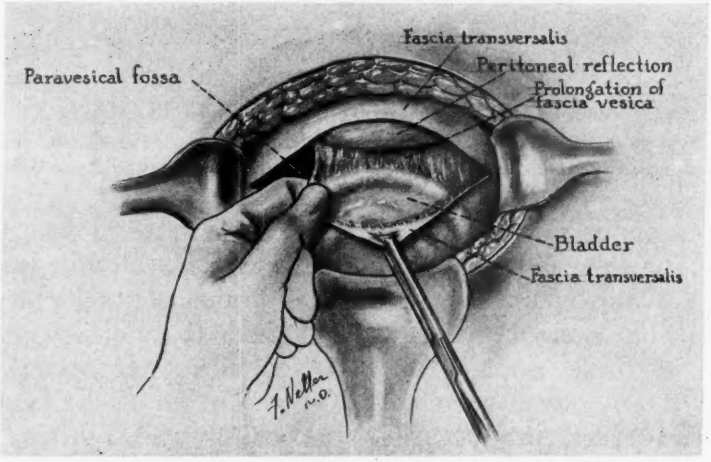

FIG. 4. Incised fascia transversalis, exposed peritoneal fold, dome of the bladder with catheter, prolongation of fascia vesicae and finger in the paravesical fossa.

the present day gynecologists of the various schools of vaginal plastic surgery without a common anatomic denominator. This by Jacob Henle, the great German histologist and anatomist. A description and hand drawing of the microscopy of the

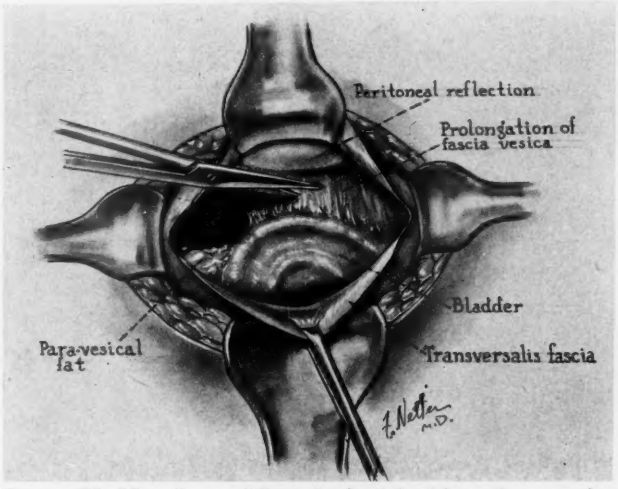

Fig. 5. Bladder elevated from its bed, incision of connecting fascia between peritoneal fold and bladder dome.

medley of tangential views has been the result of the many contributions based on gross anatomic dissections without any histologic corroboration. The true relationship of the *fascia endopelvina* to the pelvic organs and its variations from a fibrous bladder wall and vaginal wall with the intervening areolar strands appeared in his *Handbuch der Systematischen Anatomie des Menschen* (1866–1871). This drawing was reprinted in the first "system" of American gynecology published in 1887 in the chap-

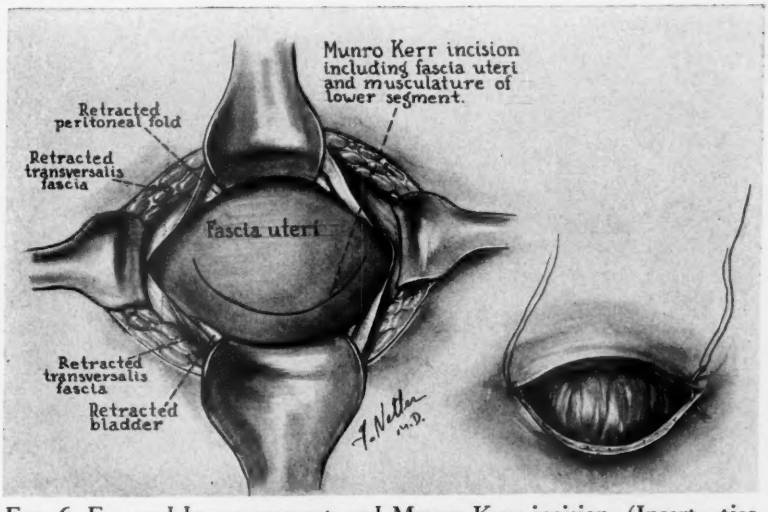
Munro Kerr incision including fascia uteri and musculature of lower segment.
Retracted peritoneal fold
Retracted transversalis fascia
Fascia uteri
Retracted transversalis fascia
Retracted bladder

Fig. 6. Exposed lower segment and Munro Kerr incision. (Insert—ties in apices of incision and presenting fetal head.)

sheath to a loose areolar pad was painstakingly studied and described (histologically) by B. H. Goff[22] (1931). The existence of this avascular line of cleavage with strands of areolar tissue was first mentioned ter on pelvic organs by H. C. Coe. It was lost sight of until redescribed by W. Blair Bell in his text on gynecology (1912). P. C. Huguier had, however, demonstrated the existence of this space between vagina and

bladder in a drawing (macroscopic) which appeared in his text, *Sur les allongements hypertrophique du col de l'uterus*, 1860.

above the internal os, and both lose their identity.

In the normal (non-pregnant) state the

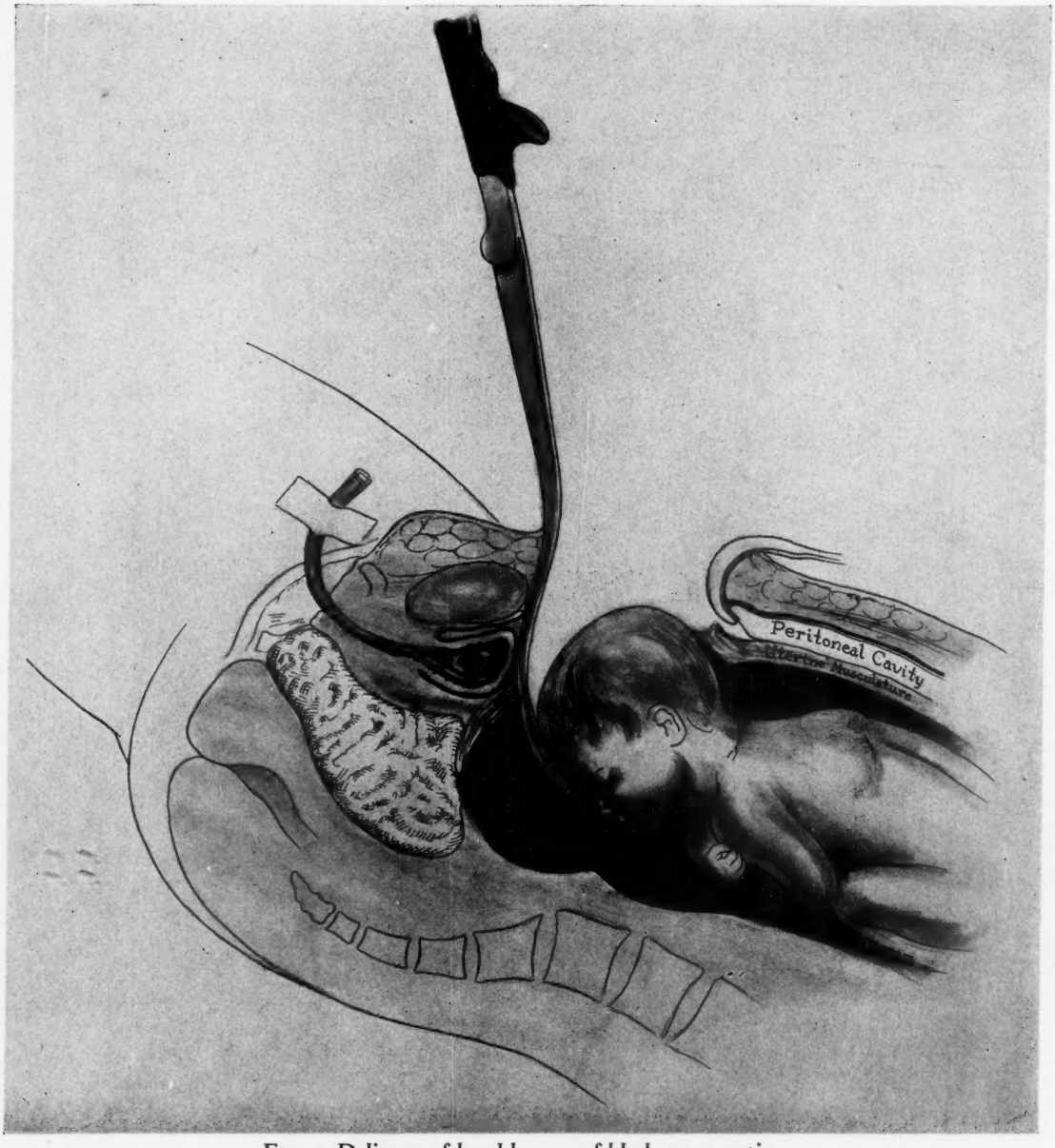

FIG. 7. Delivery of head by use of blade as a vectis.

That part of the *fascia transversalis* which descends into the pelvis has been designated as *fascia endopelvina*—with even more detailed and appropriate designations as *fascia vesicae, fascia uteri, fascia vesicovaginalis* and *fascia rectovaginalis*. The *fascia uteri*, like the visceral peritoneum becomes fused with the uterine substance approximately in the area just

posterior surface of the bladder with its peritoneal covering help to form the vesicouterine excavation. This excavation is gradually eliminated in the terminal months of gravidity, as the flattened bladder ascends the lower segment, and the peritoneal fold recedes into an elongated cul-de sac. This recession permits the formation of an avascular space bounded

by the apex of the bladder below, by the peritoneal fold above, by the prolongation of the *fascia vesicae* anteriorly and by the lower segment posteriorly. This space must be entered in order to bring the lower uterine segment extra-abdominally.

Re-reading this anatomic description with the diagram as a guide, reveals the all important fact that the bladder lies free in a cleavage space, encased in the *fascia vesicae* (save at the urethral area), below the parietal *fascia transversalis* and above the hypertrophied layer of the loosely knitted uterine portion of the *fascia endopelvina*, padded anteriorly and (particularly) on either side with a loose mesh of fatty tissue. Entering this space at the right lateral border of the bladder (the paravesical fossa), this viscus is separated by blunt dissection with index and middle fingers—separated from the sublying *fascia uteri*. With this separation completed, the bladder is gently elevated from its bed, resting on the palmar surface of the two fingers of the left hand. This maneuver brings into clear relief the bladder dome outlined by the catheter, the grayish white peritoneal reflection and a thin intervening transparent tissue—the hypertrophied prolongation of the *fascia vesicae*. This tissue is "scissored." At midpoint, the transparency fades as the peritoneum is reflected in a series of folds on the middle umbilical ligament (urachus) and on the obliterated hypogastric arteries. Nonetheless, a definite line of demarcation is visible; because in late pregnancy these folds and cords or false ligaments of the bladder are flattened and attenuated. Cognizance of this embryologic-anatomic relationship, coupled with an added dissectional care, will aid in avoiding peritoneal or bladder trauma. Thus a complete separation of the bladder dome from the peritoneum can be accomplished effectively without injury to either structure, and the lower uterine segment, with its fascial covering, is exposed extraperitoneally. The exposure is further improved by displacing the bladder downward behind the symphysis with a Doyen retractor.

This segment is incised in semilunar fashion (Munro Kerr incision), beginning in midline and as low as possible in order that the extremities of the incision may remain in the lower segmental area. Bleeding points arising from the cut ends of the musculature may be controlled by the use of Allis or Péan triangular clamps. The two ends of the incision are sutured and the sutures are held long to facilitate subsequent exposure of the cut edges and repair. The fetal head is rotated manually to a direct vertex anterior position. A solid blade (preferably the left blade of a Tucker-McLean forceps) is used as a vectis, resting on the midpoint of the symphysis acting as fulcrum. By this maneuver, and with added pressure exerted on the flanks of the patient, the fetal head is eased out and delivered. At this point it may be found advisable to delay cutting the cord for a moment while the anesthetist permits the patient to breathe an adequate amount of CO_2. This will stimulate the anesthetized infant's respiratory apparatus.

The placenta may be delivered either by a manual invasion of the fundus, if the operator is dealing with a "clean" case; or, it may be removed by traction on the cord and compression on the fundus extra-abdominally, when dealing with a potentially infected case. The author has found it advantageous to pack the uterus in the majority of instances with a moderate amount of 2 inch iodoform gauze. Assurance is made that one end of the gauze is placed at the cervical orifice to facilitate removal. Occasionally, in the cesareanized patient with an undilated cervix, this packing will soften that structure, dilate it and permit freer (sapremic) drainage. This gauze is removed in approximately thirty-six postoperative hours. The subcutaneous injection of five minums of pituitrin precedes the removal. The uterine wound is sutured in two layers with continuous chromic No. 2 catgut—the first involving the musculature; the second, the muscula-

ture and *fascia (uteri) endopelvina.* The bladder is replaced in its bed and the cut edges of the fascia transversely approximated with interrupted sutures. No drainage is necessary.

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We are not all alike in the presence of pain. Popular opinion in this respect is by no means at fault. . . . But, medicine has assumed that these differences in respect of response to pain are due to differing grades of will power and of character; when they depend most certainly on many other things yet to be determined.

From—"Surgery of Pain" by René Leriche (Williams & Wilkins).

A MODIFICATION IN THE REPAIR OF COMPLETE LACERATION OF THE PELVIC FLOOR

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AT times perfect operative technique in the repair of a third degree laceration of the pelvic floor is vitiated by a spontaneous breaking down of the repaired rectal wall. Also accidents do happen, and an enema (despite orders to the contrary) may be given after operation, with very untoward results.

For this reason I modified the repair of rectal tears several years ago so that the above described complications cannot arise. This operation has given me very satisfactory results.

Figure 1 shows the posterior vaginal wall pulled forward, the levators exposed, and the rectum with its tear and torn sphincters evident. Now, instead of suturing the tear, the rectum is further mobilized (which is nearly always easy) until the upper end of the tear can be pulled down freely to the perineal surface. The flaps so produced on either side are excised as indicated, and three 40-day chromic No. 2 catgut sutures are placed along the border of the anterior rectal wall and left long, to facilitate pulling the rectal wall into proper position after the torn sphincter ends have been approximated. The levator muscles and the torn ends of the sphincter are then united in the usual way with interrupted chromic No. 2 catgut sutures. The long sutures on the rectal wall are threaded and

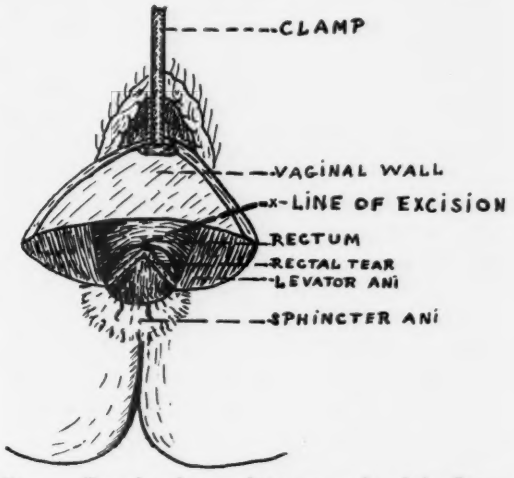

FIG. 1. Repair of complete tear of pelvic floor.

sutured to the new anterior mucocutaneous junction of the sphincter. The perineorrhaphy is then completed in the usual way.

The advantages of the described procedure are that there is no sutured gut buried deeply below the surface, and even should an enema be given, as was done in one case, the consequent ballooning of the gut does not pull on the suture line, and consequently will probably do no damage.

THE USE OF FASCIA LATA IN VAGINAL SURGERY

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MANY operations have been devised for rectocele, and all of these give satisfactory results when the rectocele or rectovaginal hernia is low in the vagina. The operation herewith described is particularly designed for high rectocele. It may also be used to repair enterocele, with or without obliteration of the sac.

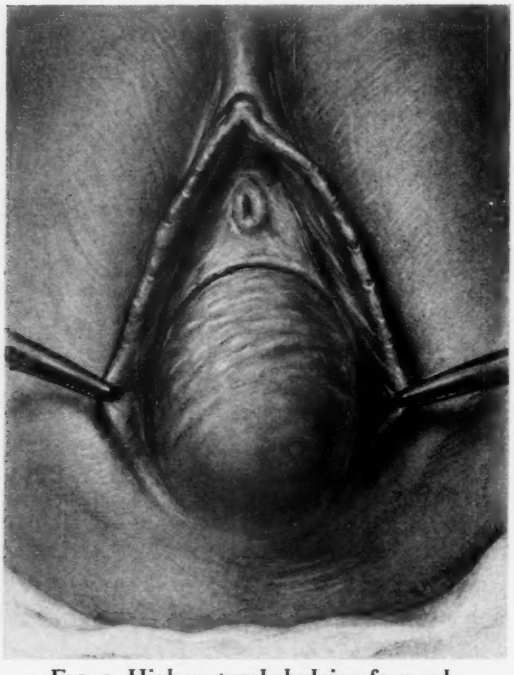

FIG. 1. High rectocele bulging forward.

The operation is done under gas-ether anesthesia. Fifty c.c. of blood are removed from the patient, and sodium citrate is added. This is then placed in a warmed, sterile dish, which is to hold the fascia strip. Warm saline may be used instead, if preferred.

One strip of fascia is removed from below upward, with the modified Masson fascia stripper, as in hernia operations. The strip is split longitudinally and the segments placed in the basin holding the patient's blood (or in warm saline).

The vagina is prepared and a transverse incision made in the perineum, as in typical perineorrhaphy procedures. The vaginal

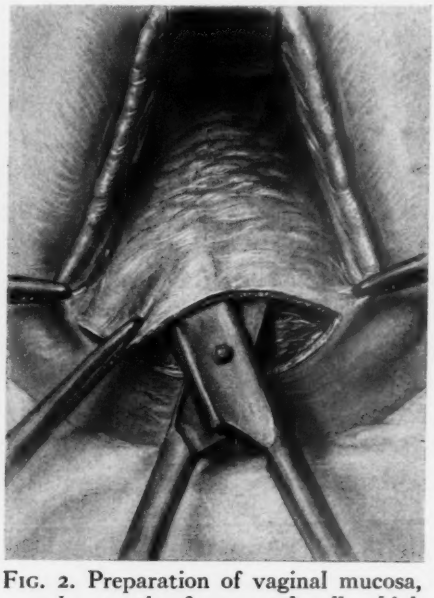

FIG. 2. Preparation of vaginal mucosa, and separation from rectal wall as high and wide as possible.

FIG. 3. Longitudinal incision in mucosa to the cervix or vault of vagina, and complete freeing of flaps.

mucosa is freed with scissors and by blunt dissection to the top of the posterior vaginal fornix. A longitudinal incision is made the entire length of the vaginal mucosa to its attachment in the vault. With blunt and sharp dissection, the mucosa is freed to the lateral walls. The entire rectum now bulges into the wound.

Beginning at the top, the wall is plicated with fine continuous catgut (chromic No. 0) on a curved intestinal needle. This plication markedly improves the condition. Two fascia strips are then inserted in figure-of-eight sutures, using Galle fascia needles to the lateral pelvic fascia. The fascia sutures are tied and the knots sutured with No. 2 chromic catgut.

The excess vaginal mucosa of the flaps is removed. The upper two-thirds of the

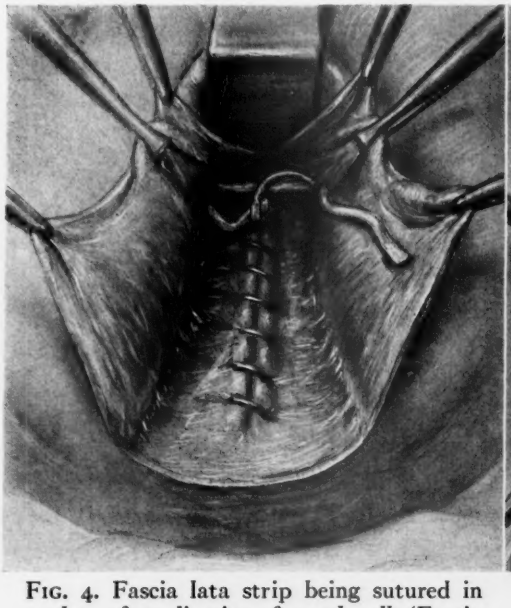

Fig. 4. Fascia lata strip being sutured in place after plication of rectal wall. (Fascia kept in warm saline or citrated blood.)

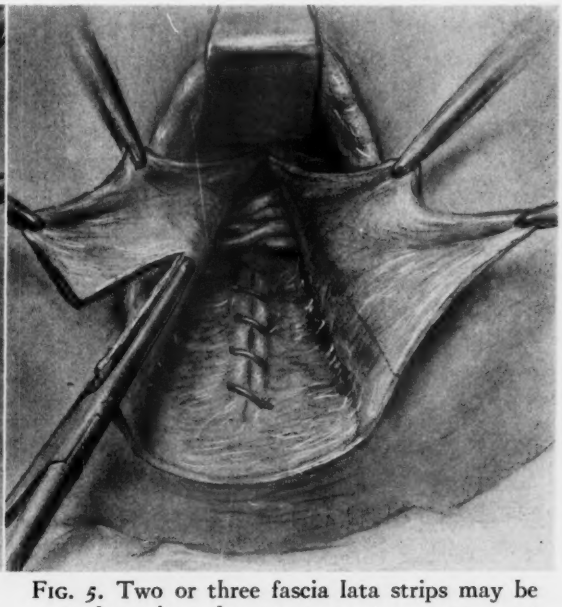

Fig. 5. Two or three fascia lata strips may be used to give adequate support to upper part of rectocele.

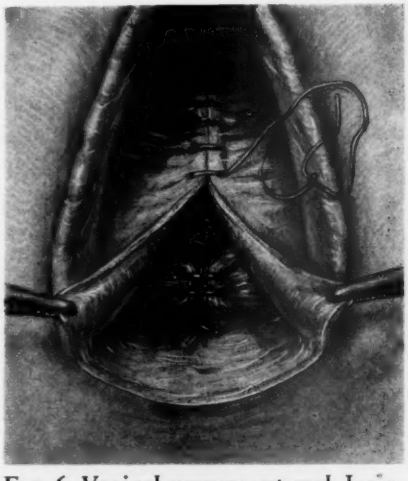

Fig. 6. Vaginal mucosa sutured. Levators approximated in midline.

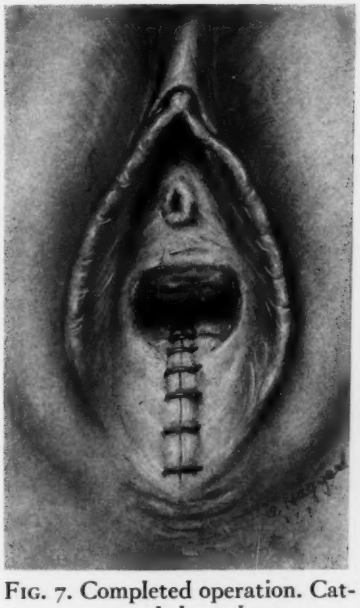

Fig. 7. Completed operation. Catgut used throughout.

incision in the mucosa are sutured with interrupted No. 2 chromic. The levators with fascial coverings are exposed and sutured in midline. A few interrupted sutures close the perineal fascia and skin.

A self-retaining catheter is inserted and allowed to remain for four days. Two tablespoons of mineral oil are given daily and a fluid and bland diet is maintained for the first five days after operation. At the end of this period, a 4 ounce olive oil enema is given.

A firm posterior vaginal wall throughout is obtained as a result of this operation. Rectal examination shows a solid anterior wall.

The fascial procedure may also be used in the repair of cystocele, fistula, and urinary incontinence. Possibly ox fascia may prove as suitable as that of the patient.

THE special susceptibility to pain of certain people, their natural hyperesthesia, even their pains, are to be regarded in terms of their individual sympathetic equivalents, depending, indeed, upon a habitual heightened vaso-motor tone, in virtue of which their nerves are continually on the threshold of suffering and of pathology.
From—"Surgery of Pain" by René Leriche (Williams & Wilkins).

THE ENDOCRINES AND SPERMATOGENESIS*

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THE rapid development of new information concerning the endocrines has resulted in the accumulation of a large and rather confusing literature. The relationship between the internal glands and the male genital system is of particular importance to the urologist because of the growing appreciation of its application to male fertility.

It is conceded that the pituitary is involved in all matters of endocrine function, and hence, it has been rightly designated as "the master gland." The basophilic cells of the anterior lobe are thought to have particular domain over gonadal development and activity, and from this lobe arise two hormones which have definite gonadotropic qualities.[1] By this it is meant that these substances have the ability to stimulate the gonads of either sex. One is called the follicle stimulating hormone or prolan A, which stimulates follicular development in the ovary, while the second is known as the luteinizing hormone or prolan B, which luteinizes the ruptured follicle. In the male they act on both the interstitial and spermatogenic cells.[2] Both of these agents may be extracted from the anterior lobe of the pituitary by alkaline solutions, but most observers believe they have not yet been isolated as separate and distinct entities.

In the normal human, gonadotropic hormones are contained in the blood and urine of the pregnant woman following production in the chorionic tissue of the placenta. A pregnancy urine extract is capable of producing an effect which is practically identical with the prolan B fraction of the anterior pituitary gland. Experiments indicate that it probably never stimulates follicular development in the female, and in the male causes only functional activation and hypertrophy of the interstitial cells of the testes. This is particularly apparent in studies on prepubetal animals.

Likewise, gonadotropic hormones are obtained from the blood and urine of the castrate male or female, most commonly, from menopausal urine. This has predominantly follicle stimulating power, and also activates the spermatogenic cells of the seminiferous tubules of the male.[3]

To summarize: There are three principal types of gonadotropic hormones in the normal human: those from the pituitary, the urine of pregnancy, and the urine of castrates. All contain varying amounts of the two fractions, but differ in their mode, degree, and type of action. Their chemical behavior suggests protein-like characteristics, but none has been completely isolated or synthesized.

A fourth source of gonadotropic substance in the human is associated with certain neoplasms of the testicle. Aside from the great clinical value of the now famous Aschheim-Zondek test for the detection of these tumors, this phenomenon has little applicability to the topic under discussion. Mention should also be made of extract of pregnant mare's serum, because of its similarity to castrate urine in hastening development of the follicle.

The identification and recognition of the characteristics of these substances has largely been accomplished by animal studies upon the rat and monkey. It is conceded that different species exhibit endocrine reactions which are not paralleled by the human. The action of the gonadotropic hormones on the ovaries of animal

* Presented before the Section of Genitourinary Surgery, New York Academy of Medicine, April 30, 1938.

and man has received greatest attention, but Smith and Engle have contributed important conclusions from studies of the male rat. If the pituitary gland is removed, involution of the germinal cells of the testes tubules results until there is a complete regression of spermatogenesis at the end of twenty-one days. When the hypophysectomized animals are treated with pregnancy urine extract there is a partial restitution of germinal tissue. When treatment is combined with castrate urine extract a remarkable regeneration follows.

Additional evidence of the close relationship of spermatogenesis and the gonadotropic hormones has been advanced by Wells and others in the study of rodents.[4] The male squirrel has seasonal breeding habits, and during estrus has increased amounts of gonadotropic material in the blood and urine. Spermatogenesis can be induced out of season by supplying these hormones.

There is, therefore, evidence at hand which indicates that appropriate use of gonadotropic substances can cause hyperplasia and hypertrophy of testicular cells in hypophysectomized animals and that they appear to be closely related to the onset of spermatogenesis in seasonal breeders.

The testicles themselves manufacture internal secretions which are known as androgens.[5] Research has been fortunate in isolating pure endocrine compounds from the gonads, some of which have now been synthesized from the cholesterol derivatives. It is possible, therefore, to check the presumed function of the gland with pure uncontaminated principles. The first androgen recovered from male urine was androsterone. Later, testosterone was isolated in pure form directly from the testicle, and it can now be prepared synthetically. Ruzička states that testosterone is twenty-five times more powerful than androsterone. Both substances stimulate comb enlargement in the capon and have direct relation to the growth and functional activity of the prostate and seminal vesicles.

It is noteworthy that both sexes contain male and female sex hormones in their blood and urine. Women normally excrete two-thirds as much androgen (androsterone and dihydro-androsterone) as do men; whereas, the normal male has about one-half the amount of female sex hormone in the urine as do women.[6]

In male castrates, the amount of excreted androgens is reduced to one-third normal. Androsterone and testosterone act differently in certain species, but it is now quite clear that in the monkey and human they have no ability to support or stimulate spermatogenesis.[7]

The thyroid is linked into the endocrine chain and a relationship of some kind exists between it and the organs of reproduction. This gland becomes enlarged in women at puberty, during menstruation, and with pregnancy. Myxedema is accompanied by sexual depression of both sexes. Little precise information is at hand, however, to explain its exact rôle, and it is probable that its influence on the testes is an indirect one.

Adrenalectomy in the male rat causes a loss of libido and potency, as well as degeneration of the seminiferous tubules. There is no convincing evidence that excess of the adrenal principle overstimulates gonad function.

Finally, it is necessary to call attention to Collip's theory of the anti-hormones. These agents are thought to stabilize or immunize the endocrine system, so that subsequent injections of hormones become decreasingly effective. It has become apparent that there is probably a "species specificity." However, this entire mechanism may be a foreign protein immunity. In other words, man exhibits no anti-hormone production against endocrine products derived from man.[8]

The health of the individual is directly dependent upon the proper functioning of the endocrine system. Disturbances which molest the usual balance of the hormones may cause profound anatomic distortions, pathognomonic of a particular type of en-

docrine dyscrasia. Gigantism, hypogonadism, and Fröhlich's syndrome as familiar examples of such dysfunction. Sterility is often an essential characteristic of some of these types, for the gonads readily share the effects of hormonal disturbances.

Lesser degrees of endocrine disorders may produce minor changes, causing inconspicuous alterations which may remain unappreciated until there is occasion to investigate a particular organ. It is now known that certain men are sterile, yet in other respects they have all the requisites for complete masculinity. They have well developed secondary sexual characteristics, faultless libido, normal sexual ability, and no appreciable abnormalities of the external genitalia. Palpation of the testes and accessory organs will detect no dissimilarity from completely normal functioning glands. The ejaculate, however, may be devoid of spermatozoa, and sections of the testicular tissue may reveal marked hypoplasia of the germinal epithelium. From this extreme to that of the normal fertile male with his full complement of millions of well shaped spermatozoa, there may be found individuals with varying degrees of deficiency demonstrating the wide range of variation common in men.[9]

Certain seminal deficiencies are due to hereditary influences, preëxisting inflammation, injuries, congenital malformations, and to general and local disease. Others may be the result of minor infractions of the endocrines, particularly the pituitary.

Stieve's illuminating descriptions and illustrations of the degenerative or regressive changes of testicular tissue in otherwise healthy men, deserves pertinent attention.[10] Graduations of atrophy were studied, and it was shown that in the early stages there was no decrease in the size of the testicle, despite disruption of complete spermatogenesis.

This and other evidence points to the possibility that spermatogenic deficiencies may, in part, be due to incomplete elaboration of one or more hormones which are intimately associated with the gametogenic cells. Such an authority as Cameron has suggested, "Thus, it is easy to imagine not only the many effects which marked abnormality of the pituitary functions can cause, but also how slight pituitary changes . . . can be reflected in so many ways."

Support for this theory in the human would be forthcoming if therapeutic response more closely followed the administration of appropriate endocrine products, producing corrective changes similar to those induced in the hypophysectomized rats. In the past, several factors have obstructed a fair application of this test. The gonadotropic products offered for clinical use are standardized by biologic assay, which conveys only an approximate estimate of the strength. The unit content or available dosage has probably been far below basic requirements. It is to be recalled that a few years ago, 10 to 15 units of estrogen were used for injection in the treatment of disorders in the female. At the present time, it is customary to give several thousand units daily over a period of weeks. Collip's principle of inverse response contends that "The responsiveness of an individual to the administered hormones varies inversely with the production of his own glands." No accurate test exists for the exact determination of the output of gonadotropic substances in the male, and accordingly, dosage has been more or less empirical and not based on estimates of need.

Despite these major handicaps, and not withstanding the many discouragements of the past, there remains the convincing animal experiments and certain isolated clinical responses which furnish a reasonable basis for continued quest and treatment. We have on record several well controlled cases, which have demonstrated gradual but progressive increases in sperm counts from originally insignificant numbers to the normal millions per cubic centimeter following prolonged use of gonadotropic hormones. These have been in the distinct minority, and were unpredictable from case to case. Three cases are

TABLE I

SEMEN ANALYSIS

Case 1. Before Treatment	Treatment	After Treatment	Result
3/21/36 M. O. C. Withdrawal Vol. 6.1 c.c. Vis. Normal Tur. Normal *pH* 8.1 Motility: 1 hr. 1 motile cell per H. P. F. 3 hr. 1 motile cell per H. P. F. 12 hr. No Motility	Daily alternate injections of anterior pituitary extract 10 units and pregnancy urine extract 100 units for 106 days. Total dosage 530 units of pituitary extract and 5300 units of pregnancy urine extract.	11/11/36 M. O. C. Withdrawal Vol. 8.5 c.c. Vis. Normal Tur. Normal *pH* 8.1 Motility: 3 hr. 20–30 active cells per H. P. F. 16 hr. 10–12 active cells per H. P. F. 28 hr. 3–5 sluggish cells per H. P. F.	Daughter born 7/18/37
Count per c.c. 2,000,000 Total 12,200,000 Morphology: Too few cells for percentage determination. Second specimen approximately identical. Comment: Low cell count; poor motility.		Count per c.c. 8,500,000 Total 72,250,000 Morphology: Normal 87 per cent Abnormal 13 per cent Comment: Improved motility, vitality, and sperm content.	

TABLE II

SEMEN ANALYSIS

Case 11. Before Treatment	Treatment	After Treatment	Result
Date: 7/7/37 M. O. C. Withdrawal Vol. 5.5 c.c. Vis. and Tur. Reduced *pH* 7.8 Motility: 2 hr. 2–5 sluggish cells per H. P. F. 2 hr. 2–5 sluggish cells per H. P. F. 12 hr. No motility	8/2/37 Alternate daily injections of anterior pituitary extract 10 units and pregnancy urine 100 units for 90 days. Total dosage: 450 units of pituitary and 4500 units of pregnancy urine extracts	1/20/38 M. O. C. Withdrawal Vol. 5.0 c.c. Vis. and Tur. Reduced *pH* 7.9 Motility: 2 hr. 50–60 active cells per H. P. F. 6 hr. 50–60 active cells per H. P. F. 12 hr. 20–30 cells motile per H. P. F. 24 hr. 1–2 sluggish cells per H. P. F.	Wife became pregnant just before semen analysis on 1/20/38
Count per c.c. 1,800,000 Total 9,900,000 Morphology: Too sparse for percentage count Second specimen confirmed above Comment: Oligospermia Poor motility		Count per c.c. 51,000,000 Total 255,000,000 Morphology: Normal 91.5 per cent Abnormal 8.5 per cent Comment: Improved motility vitality, and sperm count.	

presented here in abstract form to illustrate such favorable response to hormonal therapy.

Case I. J. B., age 35, was seen March 31, 1936. His marriage was barren, although two siblings had children. He had had mumps at age 30, with the right testicle enlarged for three to four days. He had been married for five years, had used contraceptives the first two years, but none for the past three. In spite of coitus one to two times a week, there were no signs of pregnancy.

The patient was a well developed male. General physical examination was negative. The testes, epididymes, vasa and prostate were essentially normal.

A gynecologist's report showed no reason on the wife's part to explain the infertility.

The urine and Wassermann were negative, the basal metabolic rate minus 10 per cent. The semen analysis and its reaction to treatment are indicated in Table I.

Case II. T. B., age 44, was seen June 23, 1937. He had had no serious illnesses, operations or venereal infection, but had had a chronic prostatis which was treated five years before. Of his three sisters, only one had married, and she had one child.

This patient had been married three years, having coitus two to three times a week. He had used contraceptive measures until ten months previous.

He was well developed and proportioned with normal genitalia. His wife, according to gynecological reports, had no demonstrable cause for infertility. Urine and Wassermann tests were negative. The basal metabolic rate was plus 7 per cent. Semen analysis and its change under treatment are indicated in Table II.

TABLE III

SEMEN ANALYSIS

Case III. Before Treatment	Treatment	After Treatment	Result
Date: 6/7/37 M. O. C. Withdrawal Vol. 0.4 c.c. Vis. & Tur. Reduced *pH* 8.0 Motility: 1½ hr. 3–8 sluggish cells per H. P. F. 6 hr. very occasional cell motile Count per c.c. 6,000,000 Total 2,400,000 Morphology: Too sparse for percentage count Comment: Oligospermia Poor motility	9/15/37 to 11/9/37 Alternate injections of anterior pituitary extract 100 units and pregnancy urine extract 500 units for 20 injections. Total dosage was 1000 units of pituitary extract and 5000 units of pregnancy urine extract.	12/23/37 M. O. C. Withdrawal Vol. 1.6 c.c. Vis. & Tur. Reduced *pH* 8.1 Motility: 1 hr. 80–120 active cells per H. P. F. 6 hr. 80 to 100 active cells per H. P. F. 12 hr. 20–40 active cells per H. P. F. 24 hr. 4–6 sluggish cells per H. P. F. Count per c.c. 73,000,000 Total 116,800,000 Morphology: Normal 82 per cent Abnormal 18 per cent Comment: Decided improvement. Relatively high percentage of abnormal forms.	No pregnancy reported. Check on specimen 4/15/38 was essentially same as 12/23/37.

New preparations are now offered which are five and ten times as powerful as the old ones. Cases now being treated with these refined gonadotropic principles have in some instances shown some unusual changes, not encountered during the past few years. A report at this time is hardly justified, because of the short period of observation and relatively few cases under the newer treatment. The following case is presented, however, with the full realization of this fact.

Case III. J. C. B., age 35, was seen June 4, 1937 because of possible miscarriages. He had been married two years, had used no contra-

ceptives for one year. Coitus occurred one to three times a week. Two periods had been delayed one month, which brought up the possibility of miscarriages.

The patient had had no serious illnesses, no operations or venereal infection. Of his four siblings, all but one had children.

The patient was somewhat obese, but the general physical examination proved otherwise negative. Both testicles were high in the scrotum and slightly smaller than normal. The prostate was normal. Urine was negative, as was the Wassermann test. The basal metabolic rate was minus 11 per cent. The response to treatment is indicated in Table III.

As knowledge progresses and as endocrine products are strengthened, standardized and fractionalized, it seems reasonable to believe that rational and effective therapy may evolve which will offer consistent results to certain men with impaired reproductive capacities.

SUMMARY

1. The basophilic cells of the anterior pituitary gland are intimately concerned with elaboration of gonadotropic hormones.

2. Two fractions of gonadotropic hormones are recognized: the follicle stimulating and the luteinizing fractions. These act on the interstitial and spermatogenic cells of the testes.

3. There are three principal sources of gonadotropic hormones in the normal human: (a) anterior pituitary extract; (b) pregnancy urine; (c) castrate urine.

4. All of these have varying amounts of the two fractions and act accordingly.

5. Biologic activity of these hormones is substantiated by animal experiments and human studies.

6. Androgens are derived from the gonads and are now synthetically prepared.

7. Androgens effect secondary sexual characteristics and genital structures, but probably have little action on human spermatogenic tissue.

8. Anti-hormone response may be a foreign protein immunity.

9. Minor endocrine disturbances may account for a certain percentage of seminal deficiencies.

10. Problems of treatment are discussed.

11. Three cases are presented illustrating improvement, coincidental to use of the gonadotropic principles.

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THE RADIATION TREATMENT OF CANCER OF THE BREAST

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THERE has been so much written on the use of radiation in the treatment of cancer of the breast that any additional report must have a special purpose. The following study of breast cancer is the result of years of personal observation of a group of rather unusual cases encountered at the Radiological Institute of the University of Istanbul, Turkey. Many of these patients were quite young; most of them did not seek medical advice until a relatively advanced stage of the disease. The incidence of local postoperative recurrence was unusually high, and in many of the patients cutaneous metastasis of a lymphangitic type developed. These and other peculiarities gave rise to a wealth of problems for discussion and decision and influenced our treatment considerably. The experience derived from this somewhat unusual group of cases, though not readily transferable to conditions elsewhere, may be of considerable significance to physicians interested in breast cancer.

At the present time there are two main therapeutic approaches to the treatment of carcinoma of the breast; surgery and radiotherapy with either Roentgen rays or radium. As for the surgical treatment, provided indications for surgery exist, there is fairly universal agreement as to the procedure to be employed, although—as will be shown later—even this question is not infallibly settled. The question of radiation treatment, on the other hand, is by no means clearly defined, either as to the technique or indications. There is considerable difference of opinion as to whether or not preoperative radiation should be given; as well as the appropriate interval before operation and technique of administration. Similarly, there is diversity of opinion concerning the time, intensity, duration and technique of postoperative radiation, to say nothing of additional radiation for sterilization of the younger women in the child-bearing age. These questions have not been clearly answered and deserve some discussion and clarification.

The number of patients whose symptoms and therapeutic problems constitute the basis for this report is rather small, amounting to only sixty cases. However, a continuous three year period of close personal observation and the multiplicity of symptoms and findings make this clinical material of some value. Furthermore, similar observations have been made on a far larger group of cases in the past two years; however, the latter cases are not included in this study as the period of observation is thought to be insufficient for this report.

Most of these patients came from very poor surroundings in a rather sparsely populated country, where the quality of medical attention (except for the few larger cities) cannot be compared to that of Western Europe or North America; diagnostic and therapeutic facilities in Turkey are still quite limited and women do not seek medical attention there until they are in desperate need of it. Furthermore, the older women of cancer age still suffer from traditional religious superstitions (which the younger women have partially overcome) leading to an aversion towards being examined by men.

With such conditions prevailing, it is not surprising that only four of these sixty women suffering from cancer of the breast presented themselves for first examination while the tumor was still localized, without

extension to skin and without metastasis. (Such early cases of breast cancer without skin involvement or metastatic glands comprise the so-called group I, according to the Steinthal classification.) Thirty patients had axillary lymph gland metastasis and some degree of fixation of the tumor to the skin (attributes of group II in the Steinthal grading) at the time of their first examination. Twenty-one others showed advanced local extension of the growth, axillary and supraclavicular lymph gland metastases (Steinthal III) and five others presented themselves for the first time with extensive distant metastases, in hopelessly advanced condition. The exact clinical picture, the extent and severity of the disease in these patients is not sufficiently clear from this brief description, based on Steinthal's classification. It may help to mention that of these sixty patients twenty-one had multiple skin metastases, which in a few of the cases consisted of small nodules in the mammary lymphatics, but in the majority had progressed to generalized stony hard infiltration of the entire breast and frequently to cancer en cuirasse.

To facilitate the interpretation of the findings and conclusions to be presented later, the course of the disease in these sixty cases is described briefly in the following:

Steinthal I: Four patients, operated on by radical mastectomy and then given postoperative radiation. In one of these cases there was a period of one and three-fourths years between operation and radiation during which interval cerebral metastases had already developed. This patient died of the metastases before radiation could be completed. The other three patients are symptom-free.

Steinthal II: Thirty patients, twenty-eight of whom had been operated on previously. Two patients had refused operation, and later, when they were willing to submit to it, had developed extensive skin infiltration rendering surgery impossible. Of these thirty women, twelve presented themselves for treatment with recurrences in the operative scar, nine with extensive skin metastasis. In most of these cases radiation had not been given following operation. At the start of radiotherapy in our department metastases were present as described. Seven patients, who received radiation therapy soon after operation (up to six weeks) are free of disease.

Steinthal III: Twenty-one patients, nineteen of whom underwent operation, four following previous radiation. Twelve of these women, who had been operated on, returned for treatment with local recurrences in the operative field, ten of these with extensive skin metastases. Sixteen of the patients had metastases in other organs than axilla and supraclavicular fossae. Of these twenty-one women, one is now free of all evidence of disease three years after treatment; in four other cases the primary tumor and metastatic adenopathy regressed sufficiently under radiation treatment to permit later operation. These four patients are now well even though the apparent cure may not prove to be permanent. In the remaining patients, following transitory improvement and temporary comfort, recurrence developed; some have died of metastases; others have not returned to the clinic and no further information can be given as to their outcome, which we must assume to be unfavorable. Of the remaining five patients who came for treatment with distant metastases already present, two did not return to the clinic, the remaining three died in two months, eleven months and one and one-half years after the beginning of treatment.

In reviewing this summary of results, certain features stand out: first, the fact that so few of the patients came in an early operable stage of the disease, second, that so many of the cases were operated on in stage III of the disease (Steinthal), the prognosis of which is very poor following surgery. In most of these cases radical operation was not possible and palliative procedures were carried out because many of these patients could not receive radiation

therapy due to the lack of facilities for such treatment; in addition, radiation was not infrequently discouraged by surgeons who were not convinced of its value. Furthermore, when radiation was accepted or recommended, a prolonged interval had usually transpired since operation. Very few of our cases were referred directly from the surgical clinic following the healing of the operative wounds; in most cases many months had passed before the surgeons advised radiation and their decision in general depended on the appearance of local recurrences or metastases. It is obvious that under such conditions the prognosis following radiation treatment must inevitably be bad. Furthermore, many of the patients did not come to the radiation institute for years after the operation, either because their physicians had regarded radiotherapy with doubt and suspicion or had actually discouraged it.

A striking feature of this group of cases is the unusually large proportion of patients with skin metastases, which had progressed to cancer en cuirasse in six women and in fifteen others had produced widespread nodular infiltration of large areas of skin. The treatment of such cutaneous and other metastases with their attendant severe symptoms (pain, limitation of motion and function, shortness of breath) constituted an important part of our work. The therapy was carried out in various ways and with varying results; the selection of the method or technique was often limited by the means at our disposal (nearly all patients were treated free) and the treatment could not always be administered under ideal medical conditions. Without going into the details of our therapy, it might be mentioned that our best results were obtained with interstitial radium and Roentgen rays at close focal distance to the skin, using the so-called concentrated fractionated method.

Naturally, we wondered why this particular group of cases of breast cancer should exhibit such a large proportion of cutaneous metastases (more than one-third of all our cases). While this question is difficult to answer, certain factors may have been of contributory importance. In the first place, our patients were often very young; in the sixty cases, three were under 30, eighteen under 40, and seventeen between 40 and 50 years of age. Skin metastases were especially frequent in the younger patients. In addition, the type and manner of execution of the surgical procedure may have been of importance; a large percentage of our patients were operated on even when the prognosis following such a procedure was expected to be inauspicious. Careful review of the histories, however, revealed that most of our patients with skin metastases had been operated on in the best clinics of the country (or of Istanbul) and by the outstanding surgeons; so that it is difficult to attribute such recurrences to the surgical procedure. Furthermore, it is of significance that most of the patients came for radiation therapy rather late, often too late. Finally, one wonders whether these patients with such extensive cutaneous involvement had special types of breast cancer predisposing to this variety of metastasis. From histologic study of those cases in which specimens were obtained, we could find no explanation for such tendency to cutaneous metastasis.

In the absence of a more definite explanation for such skin metastasis it may be assumed that delay or omission of radiotherapy, or its inadequate execution, may at least have been of some significance. The low standard of living conditions compared to those of Western Europe and North America probably had little to do with the prognosis in these cases; for in all patients suffering from cancer in general (including breast) in this region, we have noted relatively good resistance towards the disease, as manifested by good general condition despite widespread involvement of the body by cancer, infrequency of cachexia and the possibility of treating a large proportion of our far advanced cases as ambulatory patients.

The same factors contributing to the frequent occurrence of cutaneous metastasis in our cases of breast cancer are also responsible for our poor results in the treatment of this condition compared to those of other authors. Since the alteration of the unsatisfactory conditions depended on gradual education of the physicians and lay population, we forced ourselves to undertake the treatment of such advanced cases despite unfavorable circumstances and tried to improve the results in the radiation treatment of this desolate group of cases by variations in technique. The details of such treatment are of interest only to radiologists, but it is obvious from the brief review given above that our efforts were not entirely futile.

We are inclined to attribute the good results in the treatment of the early cases of breast cancer (Steinthal I) to radical operation, but the value of radiation even for such cases should not be minimized. The importance of radiation is indicated by the one of our four stage I cases that developed cerebral metastases, one and three-quarter years postoperatively (this being the only stage I case that did not receive postoperative radiotherapy soon after operation). It might have been possible to avert such metastases and rapidly fatal result by early radiation. We have since observed a series of similar patients with localized breast tumors subjected to surgery but not receiving postoperative radiation and returning one to two years later with extensive distant metastases; some of these cases occurred in younger women in conjunction with pregnancy.

Of thirty women referred for radiation treatment in stage II (Steinthal), we know seven to be free of all evidence of disease. In these seven cases the importance of radiation is unquestionable; for these cases were all irradiated soon postoperatively (two to six weeks) and further spread and recurrence were doubtless avoided.

The results obtained in cases irradiated in stage III (Steinthal) are of special interest. Of twenty-one patients, four were so improved by radiation that operation became possible; following additional radiation given postoperatively the supraclavicular glands disappeared and these four patients are now free of all evidence of disease three years following operation. A fifth patient has been kept symptom-free by repeated radiation. In several other cases it was not possible to cure the primary tumor or glandular metastases but it was possible to so help these women that they continued to live useful lives for considerable periods. One feature of these far advanced cases seems worth mentioning. To our surprise we observed that the cases previously operated on by radical mastectomy at the larger clinics were either not at all or very little helped by radiation. Not only was it impossible to obtain curative results or even slight improvement despite large doses of radiation but not infrequently distant metastases appeared during radiation. In contrast to these cases, the women who had been subjected to less adequate surgery in the smaller hospitals, with only partial removal of the cancerous tissue, often reacted very well to radiation treatment.

Since this peculiar reaction of previously operated breast cancer to radiation was observed in about one-third of our patients, this question becomes rather important. While it is unsafe to draw general conclusions from these cases with rather uncommon course of events, it is important to watch for similar behavior in other cases of breast cancer. At least in our series, the cases inadequately operated on (from the surgical point of view) reacted more favorably to radiation than those subjected to radical mastectomy. Two factors may contribute to this type of response: on the one hand, the danger of disseminating the disease may be greater with the more radical surgical procedure; secondly, the removal of larger masses of tissue may impair the healing capacities of the remaining tissue. In the execution of radiation treatment the protection of the normal

tissue surrounding the tumor, which is largely responsible for healing, is as important as the destructive effect of the rays on the tumor. If no such surrounding tissue is present, or if it is so damaged by previous measures that its capacity for recovery is impaired, a radiation treatment which depends in large part on such healthy reactive tissue can not be accomplished successfully. The observations mentioned above seem to confirm such impressions.

It is difficult to draw general conclusions from these advanced and often truly desolate cases of breast cancer; in other countries, women suffering from breast cancer usually come for treatment at far earlier stages of the disease and the results of treatment are apt to be more favorable. The fact that in spite of the advanced condition of our cases and other handicaps, fairly good results were occasionally obtained, particularly in the very advanced cases, is convincing proof of the effectiveness of systematically executed radiation treatment. On the basis of our experience, which corresponds to that of many others in the literature, there is no one method of treatment applicable to all cases of breast carcinoma, and in various stages of the disease either surgery or radiation is to be preferred. The selection of the method for any specific case can be made only after a thorough study of the general condition of the patient and of the special pathology. There are, however, certain general principles applicable to the treatment of breast cancer; these may be summarized as follows:

1. For tumors localized to the breast, without attachment to skin or underlying tissues, without demonstrable glandular metastases, radical mastectomy is indicated. In such cases postoperative radiation should be administered to the operative field and sites of regional gland metastasis; the radiation should be repeated in three months. In all cases in which the presence of glandular metastases is at all questionable, preoperative radiation is indicated, followed by radical mastectomy. The operation is in no way affected by such radiation and the prognosis is improved.

2. In all cases of breast cancer with skin attachment and axillary metastasis, preoperative radiation is indispensable. In many cases the tumor and axillary glands will be diminished in size and not infrequently all evidence of disease will disappear. Operation is never aggravated but is always facilitated by such radiation. Following operation, radiation should be administered and should later be repeated depending on the individual case. With such a plan of treatment it will be possible to perform radical surgery in most cases.

3. All other cases in which the tumor is already attached to the underlying tissues and in which supraclavicular glands are present should not be operated on. In this group of cases, radiation is often of great use and not infrequently leads to a disappearance of the tumor mass and the metastatic glands. Following radiation, or sometimes during its execution, it may be helpful to utilize surgery either for removal of portions of the tumor or for more complete operation if the disease has regressed sufficiently to warrant such procedure. On the basis of our experience we would advise against extensive surgical procedures in advanced cases for they seldom give good results following such surgery and the outlook following later radiation is unfavorably influenced. This statement may be questioned by surgeons, for at first glance it seems to contradict the principles of surgery. However, many surgeons advise against extensive operative procedures in such advanced cases, and in these cases the radio-therapist should be largely responsible for the entire management of the case and the recommendation of any special procedures to be carried out. The removal of large amounts of tissue should be avoided if a better result is to be anticipated by radiation in advanced cases of breast cancer.

There is an additional variety of radiation treatment which deserves special

mention and which seems indicated, on the basis of our experience. This is the sterilization by radiation of young women in the child-bearing age suffering from breast cancer. We have had the opportunity of treating an exceptionally large number of young patients with carcinoma of the breast, more than half of these patients not having undergone the menopause. We have already mentioned the apparent increased tendency to metastasis in the younger patients and the relatively malignant course of the disease in such women. In other cases, we have observed the coincidence of pregnancy and local recurrence or metastases. All these considerations have led us to sterilize by radiation all women developing cancer of the breast prior to the menopause. We have observed no unfavorable effects from this procedure and in many cases have noted a remarkable improvement in results. This procedure may constitute prophylaxis against an otherwise unfavorable outcome.

We shall not discuss here the questions of special interest to the radiotherapist, such as the time, the intensity and quality of the rays and the size of the dose as affecting the therapeutic result. Similarly, we shall not consider here the relative indications for radium or *x*-rays which may be important for the result in the individual case. Each case presents special problems which can be decided only by collaboration between internist, surgeon and radiotherapist. Nevertheless, the principles suggested for the treatment of breast cancer in general seem rational. If our experiences may prove of value to others in the management of cases of breast cancer the purpose of this article has been fulfilled.

SUMMARY

The results of radiation treatment for cancer of the breast in a rather unusual group of cases observed in Turkey are discussed. A large proportion of these cases of breast cancer occurred in rather young women most of whom first presented themselves for examination or treatment in a very advanced stage of the disease. Furthermore, many of the patients developed postoperative recurrences and an unusually high percentage developed lymphatic cutaneous metastases.

The selection of the method of treatment to be employed in the individual case depends on the general condition of the patient, the stage of the local pathology and an accurate evaluation of the effectiveness of the various possible methods of treatment from the viewpoint of the general practitioner, surgeon and radiologist. These points of view are presented with special consideration of the indications for radiotherapy. Sterilization of women in child-bearing age suffering from cancer of the breast is recommended.

EXTERNAL LATERAL DISLOCATION OF THE ELBOW*

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DISLOCATIONS and fractures in or about the elbow are frequent and, because of the commonly resulting deformities and disabilities, are a constant challenge to the surgeon. In spite of accumulated experience and a wealth of literature, many problems, involved in these injuries, remain to be solved. Having encountered, within a short time, several examples of a rather unusual type of elbow dislocation, it seems that a study and review of that type might be justified.

It is the purpose of this article to present the results of a study of external lateral dislocation of the elbow, with case reports. Dislocation of both bones at the elbow can occur in any one of four or more directions, i.e., anterior, posterior, lateral, medial, and divergent. There are, of course, variations in these general types. There seems to have been some confusion in describing lateral dislocations, some writers considering the displacement of the humerus as the basis for distinction. In this discussion, the direction in which the ulna and radius are displaced is used to differentiate between the lesions.

Dislocations are probably the most frequent of elbow injuries, exceeding fractures in most series; in one of these they constituted 20 per cent of the cases.[1] The simple posterior dislocation is the most frequent; this is followed in order by the posterior with fracture; dislocation of the head of the radius; internal lateral, or medial; and the external lateral type. In a study of a series of dislocations by Geist and Henry,[2] external lateral dislocations occurred in only 0.7 per cent. A review of other studies also shows that the external lateral type is rather rare. Newell,[3] in a series of 1,114 cases of elbow injuries, records twenty-one dislocations none of which were lateral. The case reports of this variety of dislocation, as revealed by a fairly extensive review of the literature, are appended.

External lateral dislocations of the elbow may be either partial or complete. Tinker[4] stated, "Partial outward dislocation of the elbow joint is so unusual that every case seems worth recording." He reported two cases of partial dislocation, one of which was compound. Stimson,[7] in discussing external lateral dislocation, referred to only thirteen cases of partial dislocation, including one of his own, and believed that this represented the entire number reported up to that time. Concerning complete outward dislocation, he states, "These dislocations, of which the first observation was reported by Dupuytren in 1807, although the form had been described by Petit nearly one hundred years before, were apparently so rare that Malgaigne could collect only ten reported cases. Of late, reports have so multiplied that, excluding irregular cases, those of which the description is not sufficiently detailed and those which seem more properly to belong among dislocations backward, the number of those available for study and generalization is about twenty-five." Wilson[1] reported three lateral dislocations in a series of ninety-three patients with dislocations, not indicating the type. Armitage and Armitage[5] state, "External lateral dislocation of both bones of the forearm is very rare."

Winslow[6] in reporting his only case of complete external lateral dislocation describes three varieties. He makes the following statement: "Owing to the anatomic

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FIG. 1. Case 1. Anteroposterior view of incomplete external lateral dislocation. (August 5, 1935.)

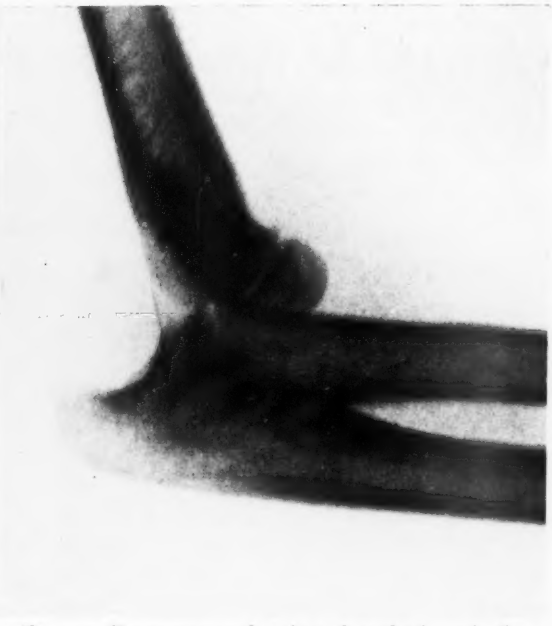

FIG. 2. Same case, showing detached and displaced portion of epitrochlea.

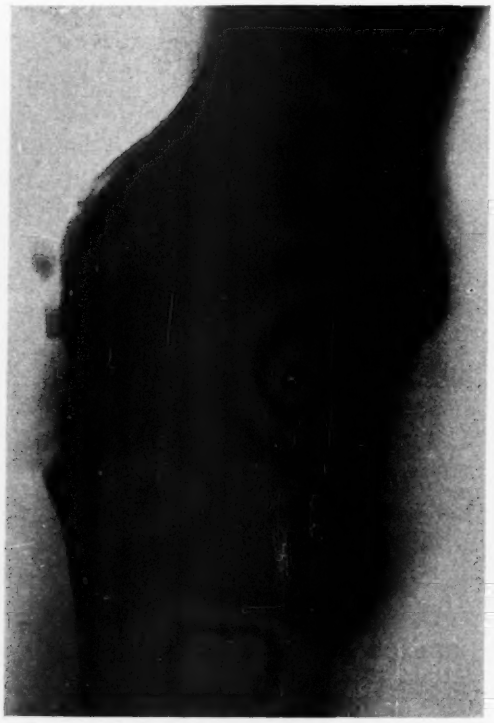

FIG. 3A. Case 1. Anteroposterior view after reduction, showing fragment of epitrochlea in proper position. (October 29, 1935.)

FIG. 3B. Same case, showing complete reduction.

complexity of the elbow joint, complete lateral dislocations are of extreme rarity." His classification is as follows:

1. Directly outward, without rotation of forearm.

2. Subepicondylar, with elbow flexed nearly or entirely to a right angle with forearm pronated, the radius being placed somewhat anteriorly to the ulna. The great sigmoid cavity is located just below the external condyle.

3. Supra-epicondylar, the forearm being flexed in pronation. The bones of the forearm are placed above the external epicondyle, with considerable shortening of the arm, which constitutes the most marked type.

Mechanism. A study of this injury indicates that it is produced by a very unusual degree or type of violence. It apparently results in most cases from a fall on the outstretched hand, although it is said to have followed a fall on the inner side of the elbow, or from a direct blow upon the forearm. Tinker[4] believed that this dislocation scarcely ever occurs in a normal adult. He further stated that it occurs only in persons who have an abnormal weakness of the capsule and internal lateral ligament of the elbow joint. This no doubt accounts for the infrequency of the lesion. Nicoladoni quoted by Tinker, believed that in most cases, evulsion of the internal condyle or epitrochlea in these dislocations is caused through the tension on the attached flexor muscles. In children, this is probably an epiphyseal separation. Tinker attributed this condition to the pull on the

Fig. 4. Lateral view in same case after reduction.

Fig. 5. Case II. Anteroposterior view, showing complete external lateral dislocation with radius and ulna impinged on the supinator ridge. (August 12, 1935.)

Fig. 6. Lateral view of same case, showing displacement of both bones and fracture at upper end of the radius.

internal lateral ligament. He produced the dislocation experimentally by abduction of the completely extended and pronated forearm. Rotation on the humeroradial articulation as a center causes the rupture of the internal lateral ligament, thus opening the joint. The sigmoid cavity of the ulna is then separated from the trochlea and its mid-ridge escapes from the groove of the trochlea, sliding over the outer ridge of this process, occupying a position varying from the groove between this ridge and the capitellum, in the incomplete form, to a position upon the supinator ridge or epicondyle, in the complete form.

Fig. 7. Case II, immediately after reduction, showing improved position of head of radius. (August 12, 1935.)

Physical Signs. Examination usually shows the forearm in a position between extension and right angle flexion, with a variance of angulation depending on the individual case. Pronation of the forearm is common and is due to pressure under the muscles which take attachment from the external condyle and are made tense. When the hand of the injured extremity hangs at the side, with the forearm adducted, the axis of the humerus is pointed downward and inward. The normal angle of the humerus is more downward and outward. The nternal condyle is made prominent, the skin being made very tense over it and it may have a rough edge if the epitrochlea has been avulsed. There is increased protuberance of the oleocranon, because the ridge of the sigmoid cavity interlocks in the deep groove between the outer margin of the trochlear surface and the capitellum. The external condyle is usually not prominent, but may be identified by making strong pressure above the head of

Fig. 8. Case III. Anteroposterior view, showing partial external lateral dislocation, with displacement of epitrochlea downward and backward. (August 11, 1935.)

Fig. 9. Lateral view in same case, showing displaced epitrochlea.

the radius, behind the extensor muscles. The very definite widening of the transverse diameter of the joint is the most prominent sign. The triceps tendon stands out as a very tense band.

Complications. These dislocations may be compound and complicated by severe injuries to soft and osseous tissues. Extensive laceration of the capsule and overlying soft tissues, particularly the musculature, may occur. The chief vessels and nerve trunks may be seriously injured, although this complication is not frequent in the literature. Jeanneney and Viella[9] cite a case in which such trauma occurred and was followed by the Volkmann syndrome. Juvara, in 1930, quoted by Papin,[10] reported a case in which there was a paralysis of the cubital nerve. These complications of the soft parts may be so extensive as to require amputation. Gant,[11] in 1866, reported a case of external latero-angular dislocation in which this operation became imperative on account of the extensive damage to the soft parts. Gerdes,[8] 1863, reported a case of complete external

Fig. 10. Case III, showing reduction, with epitrochlea still displaced, but in improved position. (September 8, 1935.)

Fig. 11A. Case IV. Anterior-posterior view, showing partial external lateral dislocation, with evidence of disturbance of external condyle and displacement of epitrochlea into olecranon fossa of humerus. (October 28, 1935.)

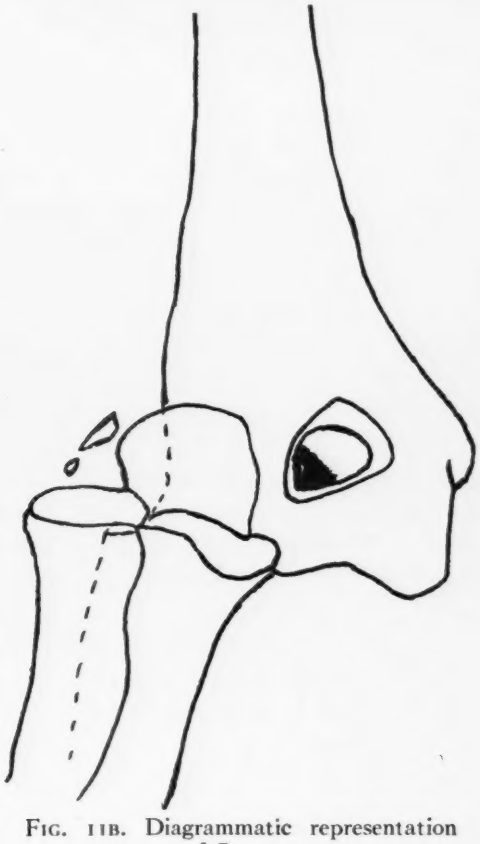

Fig. 11B. Diagrammatic representation of Case IV.

lateral dislocation, with such extensive trauma to the soft parts, that, in spite of non-injury to chief vessels and nerve

Fig. 12. Case iv. Lateral view, showing epitrochlea displaced into olecranon-fossa of humerus.

trunks, removal of the limb was deemed necessary. These amputations probably might have been avoided by the more modern débridement and aseptic technique.

The internal condyle or epitrochlea is frequently fractured or avulsed and may become interposed in the disturbed joint. This condition increases the difficulties of both diagnosis and treatment. The location of the fragment may cause an external appearance of the parts, simulating fracture of the olecranon (Papin[10]). The external condyle may also be traumatized, although this does not seem to increase the difficulty of reduction. In addition to fractures in or about the elbow joint, there may be such injuries at the lower levels of the forearm, Colles' fractures probably being the most frequent. The additional fractures are no doubt due to the unusual type and degree of violence necessary to produce this dislocation.

Diagnosis. Prompt and accurate diagnosis of injuries involving the elbow region is urgent, for upon it depends the selection

Fig. 13. Case iv. Anteroposterior view after reduction. In flexion. Showing replacement of epitrochlea and indicating damage to external condyle. (October 28, 1935.)

of the method of treatment. Treatment must vary with the kind of injury. Favorable prognosis is contingent upon adequate treatment. These are pertinent factors in caring for the dislocation under discussion. The correct diagnosis may be very evident from the physical signs, but careful *x*-ray examination should be made to establish a more accurate presentation of the conditions involved. The whole forearm should be included in this study, especially when there is evidence of gross injury in the elbow region. In two of the cases to be reported, Colles' fracture was present and added to the difficulties of treatment and prognosis.

Treatment. While our experience in the treatment of these external lateral dislocations is limited, certain points gathered from it and from a review of the reported case histories seem worthy of consideration. Injuries to the soft parts, especially to the chief nerve trunks and vessels, should receive careful attention before any manipulation is undertaken. In some cases, these injuries may be more important than the underlying fracture or dislocation. As these complications are not peculiar to the dislocation under discussion, their manage-

ment will not be further elaborated upon. Attempt at reduction should not be delayed, for early reposition must be obtained

Fig. 14. Case IV. Anteroposterior view, showing evidence of union of epitrochlea to humerus and reparative process of external condyle with thickening of adjacent periosteum. (December 2, 1935.)

Fig. 15. Same case, showing further union of epitrochlea. (March 9, 1936.)

to secure a favorable end result, and also, because reduction becomes more difficult if delayed. Older cases should have at least one attempt at closed reduction. Those eight to ten days old are difficult and are rarely reduced without operation.

General anesthesia to obtain complete relaxation is usually required, for without it effective manipulation is painful and difficult because of muscle spasm. Reduction will usually be obtained by manipulating the forearm into strong pronation, at the same time extending it and continuing with lateral flexion and supination. After reposition, the arm is put into acute flexion, depending in degree upon the severity of the swelling about the joint. Early reduction often obviates the difficulty of swelling. These cases are usually retained by a posterior moulded plaster splint, extending from mid-humerus to the distal ends of the metacarpals, with the forearm in supination. An *x*-ray check should be made promptly. This can be accomplished in the operating room before splinting. Hospitalization of such cases for several days is a wise precaution in order to facilitate observation of peripheral nerve function and circulation.

Reduction may be comparatively easy and perhaps may not require any prescribed technique other than straight traction, followed by flexion. However, certain cases may be resistant, the cause of this resistance not being evident in the *x*-ray plates. In these, continued or repeated forceful attempts at reduction should not be made for fear of added damage to the soft parts, especially nerves and vessels that may be atheromatous.

If closed reduction fails in competent hands, we agree with Winslow[6] and Papin[10] that open operation should be done at once, for, while there is risk of infection in open reduction, the importance of obtaining prompt reposition is so great that, under proper conditions, it seems worthwhile to assume this risk. Cases showing interposition of the displaced epitrochlea or other

fragments indicate early surgical interference, if manipulation does not attain proper reposition. An interposed epitrochlea should be dislodged and the elbow reduced; then if large, it may be fixed at its proper position; if small, it may be removed entirely. In one case, not personally treated but reported with this paper, open operation was done three weeks after the injury, but no attempt was made to replace the epitrochlea. Postoperative *x*-ray showed that the reduction had been maintained but with a fair-sized epitrochlea still widely displaced, with no interposition. This condition apparently has not interfered with the end result. However, we believe it wise to deal definitely with this process of bone, even if it is not interposed. Guerin, quoted by Papin,[10] cites a case in which the epitrochlea came out of the articulation, anteriorly. By means of a bodkin thrust through the skin, he replaced the epitrochlea into position.

Fig. 16. Case v. Anteroposterior view showing complete external lateral dislocation in subepicondylar position. (September 30, 1935.)

Open operation affords an opportunity for inspecting the joint with respect to disturbing elements such as interposed tissues or small bone fragments, which may have been missed in the *x*-ray picture. It allows for the careful removal of blood clots that might later undergo osseous changes and disturb joint function. This inspection of the joint cavity must be most careful, with a minimum of manipulation, and should never include digital examination. In one case presented, in which closed reduction failed, early operation revealed conditions which would have resisted any further manipulations in attempting closed reduction, and which no doubt would have resulted in further damage to soft parts. Unreduced cases will usually result in disabled and painful joints, requiring radical treatment later. Occasionally an old unreduced case may have a degree of function which does not warrant any attempt at improvement.

If there is much skin damage or swelling about the joint, operation must be delayed. However, this is a matter of circumstance and judgment. We feel that under proper conditions, patients seen within three hours after the accident and considered operative, may be operated upon at once with comparative safety, for within this period it is believed that damaged tissues retain a definite resistance to infection.

Active motion, with arm supported in splint should be started early—within twenty-four hours in cases treated by closed reduction and in thirty-six hours in cases which have received operative treatment. At first this active motion must be carefully guarded and be limited to flexion, depending upon the degree of pain and swelling. Under strict supervision, pronation and supination with flexion should follow, so that within three or four weeks satisfactory function should be attained in most uncomplicated cases. The more complicated cases will also show a better percentage of good results, if early, properly supervised active motion is instituted. Proper physiotherapy is also an aid to recovery, but should not be depended upon to the exclusion of the patient's own motion. One of the causes of unsatisfactory results in elbow joint cases has been prolonged immobilization. Some of the earlier writers recognized this factor which has been too much overlooked in later years.

F. M. Johnson,[12] in 1880, called attention to the danger of fixing joints for too long a period, citing an elbow case with resulting ankylosis from such a procedure. He advocated passive motion. However, we feel that careful active motion is the better method. H. J. Bigelow,[13] in 1868, spoke of the "general impropriety of passive motion in treatment of fractures and dislocations of the elbow joint."

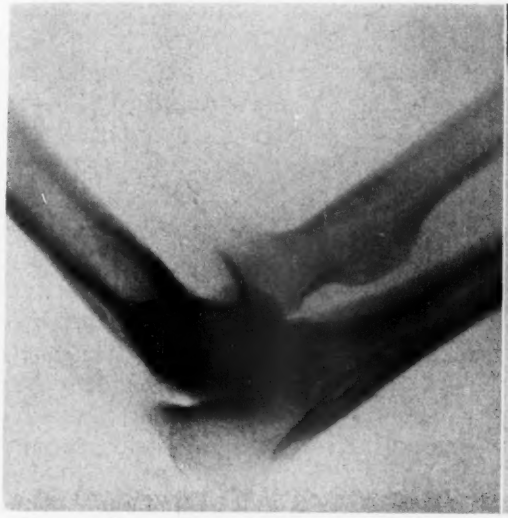

Fig. 17. Case v. Lateral view, showing lateral displacement with a splinter fracture of the ulna. (September 30, 1935.)

Fig. 18. Same case, showing reduction, with slight upward displacement of fragment of ulna. (October 1, 1935.)

Prognosis. Prognosis must always be guarded in these cases as in any injury involving the elbow joint. Even though complete and early reduction has been obtained in a simple case, secondary joint changes may take place and cause more or less disability. The causes of these disabling alterations have not been entirely explained. Certain writers believe that, because of the numerous centers of ossification in the elbow region, an injury involving them may cause irritation with resulting excessive ossifying changes in the fracture lines, as well as ossification of blood clots and damaged muscle tissues. Such changes may occur in the absence of demonstrated fracture lines.

These cases should have adequate follow-up treatment and observation and be finally rated as to result at the end of a year. This procedure is not always possible and end results cannot always be ascertained. However, we believe that, if early reduction is accomplished in these dislocations, whether simple or complicated, the results will be much improved.

CASE REPORTS

Case 1. A. G., aged 10 years, entered the hospital August 5, 1935 at 8 P.M., immediately after a fall on his outstretched hand. Examination showed a deformity of the right elbow with marked widening. The forearm was held in extension, with slight pronation. The diagnosis was an unusual dislocation of the elbow, with possible fracture. There was no disturbance of the peripheral circulation or nerve function. *X*-ray examination (Figs. 1–4) showed an incomplete external lateral dislocation of the elbow joint, with avulsion of the epitrochlea.

Treatment. Under general anesthesia, an attempt at reduction was made immediately. This was unsuccessful and, as further effort seemed useless, it was abandoned for fear of causing added injury to the soft parts. The cause of failure was not evident on further examination or in a study of the *x*-ray plates. Consent for immediate operation could not be obtained. The patient was put to bed, with forearm in traction; this treatment was maintained for twelve hours. It was hoped that this traction might overcome the muscle spasm and perhaps allow reduction. A second effort to reduce was unsuccessful and permission for

operation was given. The operation was performed about thirteen hours after the accident. A posterolateral incision exposed the interior

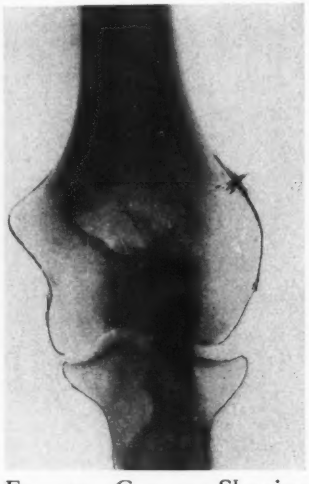

Fig. 19. Case v. Showing complete reduction. (October 1, 1935.)

of the joint, revealing a situation that would have defied any attempt at closed reduction. The radius was displaced anteriorly with its head forced upward through the orbicular ligament and the anterior portion of the joint capsule. It was firmly fixed in this position by a constricting band around it, immediately below the head. Before reduction could be accomplished, this band required incision. The joint was then carefully flushed with normal saline solution, removing a moderate amount of partially clotted blood. After reduction of the joint and replacement of the epitrochlea, the torn orbicular ligament, joint capsule and other injured tissues were repaired with catgut. The skin was closed with silkworm gut tied over small rubber tension tubes. Retention of position was obtained by use of a posterior moulded plaster splint, extending from the middle of the upper arm to the distal ends of the metacarpals, with elbow flexed slightly less than 90 degrees, forearm being placed in supination.

Postoperative Course. This was uneventful, with no rise of temperature or other complication. Slight active motion in splint was started within twenty-four hours. This was increased as conditions permitted. The wound healed normally and the patient left the hospital on the tenth day. The splint was removed entirely at the end of the third week. Motion at this time was fair in all directions. Restriction in extension was the most marked impairment.

Three months after the injury all functions of the elbow were recovered, with the exception of complete extension, and this returned in an additional two weeks. One year after the injury, there was no impairment of any of the functions of the elbow joint.

Case ii. Mrs. H. M., aged 79 years, entered the hospital August 12, 1935, shortly after having fallen on her outstretched right hand. Examination showed gross deformity of both right wrist and elbow, with a small bleeding wound over the ulna about 2 inches below the olecranon. There was marked discoloration and swelling of the upper third of the forearm and about the elbow. No disturbance of the peripheral circulation or nerve function was noticed. The elbow was considerably widened with prominence of the internal condyle of the humerus. The forearm was pronated and definitely shortened. Diagnosis of external lateral dislocation of the elbow, with a Colles' fracture and a compounding wound of the ulna was made. *X*-ray study (Figs. 5–7) showed a complete external lateral dislocation of the elbow, with a fracture of the head of the radius. In addition, a Colles' fracture with marked displacement was noted.

Treatment. Under gas-oxygen anesthesia, the dislocation was easily reduced by using straight traction followed by flexion. The wound, which was not deep, was treated and tetanus antitoxin given. The Colles' fracture was manipulated into satisfactory position, and anterior and posterior moulded plaster splints were applied to the forearm. On account of the swelling about the elbow, the splints were not made to include that joint. The arm was placed in 90 degrees flexion. *X*-ray (Fig. 7) showed complete reduction of the dislocation, with satisfactory position of the bones involved in the Colles' fracture. The position of the head of the radius, while not entirely satisfactory, was considered to be the best that could be accomplished at the time.

The swelling receded rapidly and the wound caused no trouble. Guarded active motion was begun at the elbow on the second day and at the wrist on the third day. The patient left the hospital on the fifth day. Two months after the injury, there was good motion at the wrist with slight restriction in extension of the elbow. Flexion was complete. Supination of the forearm was somewhat restricted.

By February, 1936 there was complete restoration of function at the wrist and elbow except for restriction of supination. In August there was the same restriction of supination as at the previous examination. However, the function of the wrist and elbow was generally satisfactory, considering the injury encountered and the age of the patient. She was able to do light work about the house and was satisfied with the outcome.

Comment. This case is an example of the complete supra-epicondylar type and illustrates easy reduction, in spite of complicating factors, which adversely affected the outcome.

Case III. M. S., aged 52 years, was admitted August 9, 1935, shortly after having fallen down a flight of five steps, landing on the left side with the entire weight of her body on the left forearm. Examination showed a deformity of the left wrist and marked swelling and widening of the elbow. There were also multiple lacerations about this region. No disturbance of peripheral circulation or nerve function was evident. The wrist had been fractured several years before, slight impairment resulting. *X*-ray examination (Figs. 8 and 9) showed a fracture of the distal end of the radius with position fair, and also an incomplete external lateral dislocation of the elbow, complicated by avulsion of the epitrochlea.

Treatment. Several unsuccessful attempts at reduction under the fluoroscope were made. Open operation was advised, but was delayed because of the condition of the skin about the elbow. On August 30, 1935, three weeks after the accident, open operation was performed. A posterior Kocher incision was used to expose the area. After cleaning out the olecranon fossa, reduction was easily obtained. No attempt was made to replace the epitrochlea. Position was maintained by the use of a posterior angular splint.

Fig. 20. Case VI. Lateral view showing marked comminution.

Fig. 21. Case VI. Anteroposterior view showing partial external lateral dislocation in subepicondylar position with a large fracture of external condyle and displacement of a smaller unidentified fragment below joint.

The postoperative course was uneventful, with no evidence of infection. Early motion of the wrist and elbow was started. On the patient's discharge from the hospital two and one-half weeks after operation, there was a fair degree of function, with, however, some limitation of flexion and extension.

Seven months after the injury, the patient was able to do her usual housework. Flexion of the elbow was complete, and extension was 75 per cent of normal. Pronation was complete with 75 per cent of normal supination. There was slight pain in the wrist. In August 1936, there was general improvement of all

functions, although there was still slight restriction of supination.

Comment. This case illustrates the type due to a fall directly on the elbow and forearm. We do not feel that the several attempts at reduction under the fluoroscope were wise, as the swelling and skin lacerations about the joint were aggravated, thus prolonging the preoperative period. Also we think it would have been more judicious to have dealt more definitely with the avulsed epitrochlea.

FIG. 22. Case VI. Lateral view after reduction showing considerable anterior displacement of external condyle. Later views indicated improvement.

FIG. 23. Case VI. Anteroposterior view after reduction.

CASE IV. J. I., aged 14 years, was admitted October 28, 1935, shortly after sustaining a fall on his left elbow. Examination showed considerable discoloration, with widening and marked swelling of the elbow joint. The arm was held in moderate pronation. Peripheral nerve function and circulation were not disturbed. The diagnosis of external lateral dislocation of the elbow, with possible fracture of the olecranon, was made. *X*-ray study (Figs. 11 and 12) revealed a partial external lateral dislocation of the elbow, with a comminuted fracture of the external condyle, a fragment of the internal condyle lay in the olecranon fossa of the humerus.

Treatment. Under general anesthesia, apparently satisfactory reduction was obtained after considerable difficulty. Excessive force was not used. *X*-ray (Fig. 13) showed reduction complete, with the fragment of the internal condyle in good position. Because of the marked swelling, no attempt at splinting the elbow was made. The patient was put to bed with his forearm held at right angle flexion. Heat was applied and slight active motion was allowed on the second day. On the third day the swelling had subsided sufficiently to allow the application of a posterior moulded plaster splint, with a slight increase of flexion. The patient was discharged the same day, reporting to the Out-Patient Department two days later when increasing active motion was started.

At the end of the fourth week, motions of the joint were normal except for slight restriction of extension. Four and three-fourths months after the injury, examination showed complete return of function, with union of the replaced fragment of the internal condyle. (Fig. 15.)

Comment. This is an example of the type of injury due to a direct fall on the elbow. It indicates that, even in the presence of an interposed fragment, satisfactory closed reduction may at times be accomplished and that such a replaced fragment may become firmly reunited to the contiguous portion of the humerus.

CASE V. S. D., aged 56 years, was admitted September 30, 1935, several hours after a

fall on the outstretched left hand. There was deformity, with marked widening of the left elbow. A diagnosis of external lateral dislocation was made. No disturbance of the peripheral circulation or nerve distribution was found. *X*-ray (Figs. 16 and 17) showed a complete external lateral dislocation of the elbow, with a splinter fracture of the olecranon.

Treatment. Under general anesthesia, reduction was obtained without any difficulty, by using straight traction followed by flexion. *X*-ray check (Fig. 18) indicated complete reduction of the dislocation with the fragment of the olecranon in fair position. A posterior moulded plaster splint was applied with arm in acute flexion. Patient refused to be admitted to the hospital and was sent to her home some distance from the city. No further record was obtainable, so that the end results cannot be known. However, with the prompt and satisfactory reduction, we believe that a useful result was obtained.

This case represented the subepicondylar type.

Case vi. Mrs. H. W., age 55 years, was first seen July 9, 1938, twenty-two hours after a fall on the right elbow and after an unsuccessful attempt at reduction. A description of the original deformity cannot be given. The original *x*-ray plate showed an external lateral dislocation, and a fracture of the external condyle with displacement of a large fragment laterally and a smaller unidentified fragment lying some distance below the joint. The unusual type of dislocation had not been recognized. At the time of examination there was no disturbance of peripheral circulation or nerve function.

Treatment. Under general anesthesia, strong traction with pronation followed by supination and flexion was made. Retake in operating room showed satisfactory reduction. Fixation in plaster splints, in acute flexion was applied. The patient was discharged the next day, with instructions as to early active motion. On August 16, function was good, with slight restriction of extension. By December recovery was complete.

Comment. This was a case of the subepicondylar type. In spite of delayed reduction, a good result was obtained.

SUMMARY

1. A study of external lateral dislocation of the elbow is presented, indicating that reported cases of both complete and incomplete dislocations are infrequent.

2. This type of dislocation is often complicated by fractures, in or about the elbow and at the lower levels of the forearm. Therefore, an *x*-ray study of the whole forearm should always be a part of the examination.

3. As early recognition is of importance, the chief of service should see such cases promptly.

4. Reduction, under general anesthesia, should be attempted at once, but the force exerted should be gentle.

5. If early closed reduction fails, open operation should be performed at once, especially if there is interposition of bone fragments.

6. Extensive skin lacerations and joint swelling, as a rule, contraindicate operation. However, operation may be considered in these cases if they are seen within three hours after accident, as tissues retain a resistance to infection within this period.

7. Open reduction permits inspection of the joint and removal of interposed tissues and extravasated blood, while reducing the possibilities of later joint changes.

8. Fixation should be maintained in supination with flexion to such an acute angle as may be permitted by the swelling.

9. It is a wise precaution to hospitalize these patients several days for observation.

10. Early active motion is essential in either open or closed reduction to obtain early restoration of joint function.

11. As in all elbow injuries, prognosis must be guarded.

12. Adequate follow-up supervision is indicated for a proper rating of end results.

13. Six case reports are given.

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I have many times seen a doctor whose muscles are not 50 per cent as strong as the muscles of his patient, trying to reduce a fracture with his own hands without any form of mechanical contrivance to help him. From—"Fractures" by Paul B. Magnuson, third edition (Lippincott).

TREATMENT OF SHOULDER DISLOCATIONS

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IN the treatment of a dislocated shoulder, the surgeon must first consider his patient's safety and comfort in securing a good functional joint as rapidly as practical; and the surgeon must secondly protect himself against the ever-growing problem of malpractice suits. The patient is protected by care and attention to diagnosis, anesthesia, reduction, and after-treatment; the surgeon is protected by roentgenograms before and after reduction, and adequate records with full notes of any nerve or blood vessel injury, made before the arm is touched and preferably made before witnesses. Convenient methods are now available for printing data directly upon the emulsion of an *x*-ray film thus forming an unremovable label, difficult to falsify, upon which may be recorded the patient's name, date, hour, whether a pre- or post-reduction film, etc. The surgeon may thus further protect his *x*-ray films from being lost or mixed.

The following article presents a correlation of the author's experience, and some of the more recent methods of treatment described in the surgical literature. The presentation is from the viewpoint of the general surgeon or general practitioner who may lack the facilities and training of the orthopedic surgeon; special orthopedic skill is needed in the treatment of some of the more extensive shoulder injuries, but most shoulder dislocations can well be treated by the general surgeon. Closed reduction is advocated whenever practicable, because the end results of open reduction are not always gratifying, even in the best of hands. Closed reduction gives equal or better results with less immediate disability and less expense to the patient.

Etiology. Young adult males most commonly suffer humero scapular dislocations. Heavy labor or athletics often supply the needed violence. Muscular contractions of epilepsy or other seizures may also result in shoulder dislocations.

The classical mechanism resulting in this injury is a backward thrust on the hand or arm, when the arm is in a position of abduction and external rotation. The result is an anterior or subcoracoid dislocation of the shoulder; the humeral head is forced through the inferior aspect of the joint capsule and slips forward under the coracoid process.

The following case report illustrates that the muscle spasms of an epileptiform seizure may force the humeral head through the joint capsule, even in the absence of abduction.

CASE 1. A 31 year old housewife complained of pain in her shoulder for five days, beginning immediately after she suffered a severe convulsive seizure in bed at night. The seizure was observed by the patient's husband who is certain that no abduction of the arm occurred. The patient had had previous epileptiform seizures but never any sort of shoulder injury. After recovery from the seizure, there was severe pain and limitation of motion of the left shoulder. Five days later, when she was first seen, a subcoracoid dislocation of the shoulder with avulsion of the greater tuberosity was found. Reduction was readily accomplished under brachial plexus anesthesia by the method of Zierold.[12]

Numerous other types of violence cause dislocated shoulders. Some unusual accidents and diseases causing this injury are: falls through a trap door or hole in the floor with arms forced above the head; puerperal convulsions; painting a ceiling; carrying a load on the shoulder; diving.

Diagnosis. The diagnosis of dislocated shoulder is usually easy to establish; mobility of the shoulder is very limited; there is a hollow beneath the acromion

process; the head of the humerus is palpable in its abnormal position, usually beneath the anterior axillary fold. The shoulder may be dislocated upward, downward, backward, or forward, but by far the most common is the forward or anterior dislocation.

In addition to the diagnosis of dislocation, any blood vessel, nerve, or bone injury must be determined. An anteroposterior roentgenogram will demonstrate avulsion of the greater tuberosity in about 7 per cent of cases,[10] and fracture of the surgical neck in about 0.5 per cent. Paresthesia or paralysis indicating brachial plexus injury occurs in 3 per cent. The radial pulse should always be felt, to help exclude pressure or injury of the axillary artery.

The value of roentgenograms both before and after reduction cannot be too strongly emphasized, both as an aid to accurate diagnosis and treatment and as a protection to the physician should his patient choose to allege that bony injury was caused or increased by the manipulation. The same is true of a careful record of evidence of soft tissue injury; the record should be made before any manipulation is carried out, and preferably in the presence of witnesses.

Treatment before Reduction. Reduction should be performed as soon as practicable; delay means prolonged disability. Pain should first be relieved by a hypodermic injection of morphine if it is necessary to transport the patient some distance for reduction or *x*-rays. It may be possible to reduce a dislocated shoulder with no other anesthesia in a fair proportion of cases, but as the suffering is usually severe, the author considers anesthesia advisable. Patients suffering from recurrent dislocation usually require no anesthesia, but in dislocations of previously well shoulders, much unnecessary pain can be avoided by the judicious use of some anesthetic agent, either regional or general.

Ethyl chloride used by inhalation to induce a state of analgesia has proved very satisfactory in the author's hands in the reduction of recent dislocations. The equipment is extremely simple: a cylinder of ethyl chloride and a gauze mask. If the cylinder is placed in warm water for a few minutes before use, a freer flow of the drug is obtained. The patient's eyes are protected with a towel, and the mask is placed over his nose and mouth. The ethyl chloride is sprayed on the mask in a constantly moving stream to prevent freezing. The patient is instructed to count between breaths. When the counting stops or becomes confused, the patient is in an analgesic state much lighter than surgical anesthesia, and hence with a wider margin of safety. The dislocation may now be painlessly reduced, though the patient is often aware of what is going on and may even feel the "plop" that occurs when the head slips into place. The margin of safety of ethyl chloride is wide when used in this manner; the drug is contraindicated in the presence of liver damage or severe arterial disease; nausea and vomiting are uncommon.

For a more difficult reduction, such as one neglected for twenty-four hours or more, or one complicated by fracture of the surgical neck, a more prolonged anesthesia is needed. Ether or ethylene may be used. The author has found a regional nerve block permits deliberate manipulation without pain and avoids some of the risks and discomforts of general anesthesia; the method is particularly valuable when the patient has a contraindication to general anesthesia.

To induce brachial plexus block, the patient lies with his head drawn away from the involved side; a needle is introduced at a point 1 cm. above the midpoint of the clavicle; with the forefinger on the subclavian artery as a guide, the needle passes inward, downward, and backward in the direction of the fourth dorsal vertebra, until the first rib is reached. The rib usually lies at a depth of about 3 cm. If paresthesias of the arm occur, 15 or 20 c.c. of 2 per cent procaine hydrochloride solution with ad-

renalin are injected; if no paresthesias are obtained, 10 c.c. of the solution are injected, the needle reintroduced to strike the

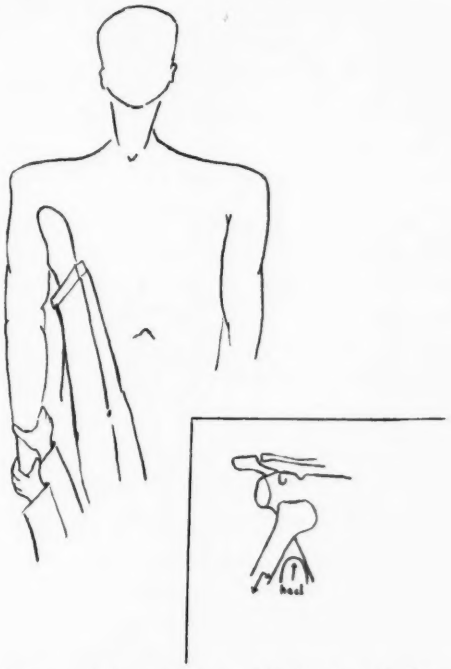

Fig. 1. Hippocratic method of reducing shoulder dislocations.

lateral margin of the rib and another 20 c.c. injected here. This procedure differs from a block to anesthetize the arm; the branches of the branchial plexus to the shoulder joint come off high up and stream over the lateral margin of the first rib; a successful block of the shoulder joint may give incomplete anesthesia of the arm. Fifteen minutes should elapse from the time the procaine is injected until manipulation is attempted.

Bohler[5] injects 2 per cent procaine solution into the hematoma in fracture dislocations. Tietze[8] advises a wide infiltration of the shoulder muscles, as described below.

Reduction. Reduction may be accomplished either by traction, with or without pressure on the arm or the humeral head, or by manipulation to slide the head through the rent in the capsule. Kocher's maneuver is the most widely described method that uses manipulation without traction; briefly, it consists of external rotation of the arm which is flexed at the elbow, adduction of the elbow to the midline of the body, then internal rotation of the arm. This method is very widely recommended and used, and its value is unquestionable. However, the

Fig. 2. Zierold's maneuver.

author has not found this maneuver universally successful. It may have to be repeated in order to effect reduction, and is not very useful in neglected dislocations. Because of the range of motion that the humeral head is put through during the manipulation, the possibility of considerable soft tissue damage exists, and there is some risk of fracture of the surgical neck. Kocher's method is contraindicated in dislocation with fracture of the surgical neck.

The Hippocratic method (Fig. 1) is a form of traction plus pressure on the humeral head. It consists of strong traction on the involved arm by the operator's hands which grasp the patient's wrist. Pressure on the humeral head is made by the operator's unbooted heel pressed into the patient's axilla. A slight levering motion of the arm toward the body helps to lift the head over the rim of the glenoid fossa. Bohler[5] advocates routine use of the Hippocratic method in recent uncomplicated dislocations. Though usually safe, the method carries some risk of brachial plexus injury by pressure of the heel in the axilla. The method is contraindicated in fracture of the surgical neck.

Traction at a right angle to the long axis of the body is free from the objections to Kocher's or the Hippocratic maneuver. Its

object is to overcome the resistance of the spastic shoulder muscles, free the head from where it is engaged, and allow the head to fall into the glenoid. It is the only practical method of closed reduction of a fracture dislocation involving the humeral neck, and is quite satisfactory as a routine method in uncomplicated dislocations.

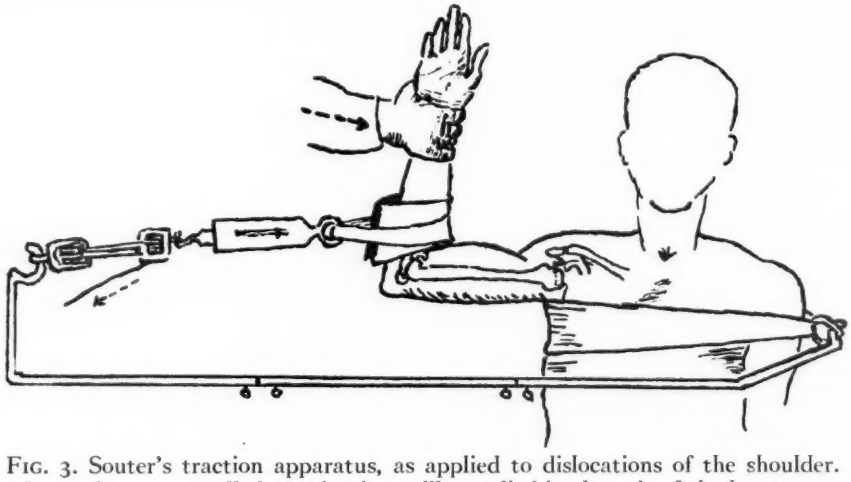

Fig. 3. Souter's traction apparatus, as applied to dislocations of the shoulder. Intermittent controlled traction is readily applied in the axis of the humerus.

Lateral traction may be accomplished in a variety of ways, among which the most useful are: traction by the operator's hands upon the patient's wrist, with countertraction by a swathe around the body; Zierold's[12] maneuver (Fig. 2); Souter's traction apparatus[2] (Fig. 3); screw traction with the leg supports of the Hawley table;[1] Bohler's traction frame.[5] Pressure on the humeral head may be used in combination with any of these forms of lateral traction, if traction alone fails.

Zierold's maneuver is particularly useful because it requires no apparatus other than the operator's hands and forearm and because it applies a powerful, easily controlled traction and countertraction. The operator's forearm (Fig. 2) forms a fulcrum for the patient's forearm which acts as a lever. It is effective in old dislocations if not too long neglected.

Treatment of Neglected Dislocations. The longer a shoulder remains dislocated, the more difficult becomes the reduction and the less satisfactory the end result. Fibrosis begins within ten days and within two months is so extensive as to make reduction exceedingly difficult. Conservative closed methods are indicated before operative reduction should be considered unless it seems obvious that extensive changes have occurred that will prevent closed reduction.

Neglected dislocations require anesthesia, either regional or general. As soon as pain is controlled, the more simple methods of reduction should be tried. Zierold's maneuver is particularly valuable. Kocher's method or the Hippocratic method may be attempted but are much less useful than they are in recent dislocations.

Regele[7] of Bohler's clinic describes the following procedure, intended as an auxiliary method in the reduction of neglected dislocations: "After loosening the dislocation by traction and possibly by lateral displacement of the humeral head (with heel, or with both thumbs), the patient lies supine, the elbow of the flexed arm is placed so that its perpendicular projection falls approximately in the region of the sternoclavicular junction of the same side. The shoulder is firmly supported, and with strong, accurate pressure in the axis of the humerus, the head springs into place." (Fig. 4.)

Since excessive injury to the soft tissues is to be avoided, long continued or repeated manipulation is contraindicated. Lateral traction, either continuous or intermittent, will most often successfully reduce a

neglected shoulder dislocation, when more simple methods fail. Souter's traction apparatus, with 10 to 20 pounds pull, intermittently applied, is recommended by Thomas.[2] (Fig. 3.)

Bohler employs a screw traction frame with a transfixion pin through the olecranon process; this same frame can be left in place during an operative reduction, and facilitates freeing the head where it has become adherent and aids in moving the head into place. Screw traction may be obtained by fastening a swathe around the patient's body to one leg piece of a Hawley table and a hitch around his wrist to the other. The leg pieces are set at a right angle to the table and can be screwed apart, providing controlled traction.

A method for avoiding open reduction is described by Tietze and merits some consideration when one is faced with an exceedingly difficult reduction. He states: "—In our clinic we have established the following policy: the joint capsule is filled with ½ per cent novacaine without adrenalin, and the entire shoulder girdle musculature, particularly the subscapularis, is infiltrated with the same solution. Reduction is now attempted. Should this fail, we abandon the effort, and every two days, infiltration of the musculature is carried out. It then becomes possible to overcome the muscle spasm, rotate the head, and fix the arm in 60 degree abduction. After eight days, a second attempt at reduction is made, and in most cases the result is obtained."

Treatment after Reduction. The presence or absence of bone, blood vessel or nerve injury determines the plan of treatment after reduction. These complications are best treated on an abduction spint. In uncomplicated dislocations a simple sling suffices; no dressing is required after twenty-four hours. Active motion is then begun; the patient is taught certain simple exercises:

1. The patient leans forward, allowing his arms to hang loosely; he then fixes the position of his arms relative to his body, and straightens his trunk. The result is that gravity has helped to move the arms to as much as a right angle with the body and the patient's muscles can then maintain the position although he is unable to move the arms against gravity to such a position.

Fig. 4. Regele's maneuver for reduction of neglected dislocations. The elbow is placed in the vertical projection of the sternoclavicular joint of the same side, and a thrust made in the axis of the humerus; the head of the bone can thus be made to slip into the glenoid fossa.

2. The patient leans forward and swings a 2 pound weight, thus carrying the shoulder into abduction by gradually increasing the swing.

3. The patient stands with his injured shoulder towards a smooth wall; his fingers creep up the wall, thus abducting his shoulder; a mark is made at the highest point reached, and attempts are made each day to exceed the previous day's record.

4. With his arm at his side, the patient forces the back of his hand firmly against a wall—thus setting his deltoid without moving the shoulder joint. Deltoid setting may be begun the day of the injury to help avoid deltoid atrophy.

The patient's progress should be followed carefully, and should improvement fail to occur in three or four days, an abduction splint should be worn constantly except when exercising, until abduction to 140 degrees is possible. The arm should not be fixed at the side with a sling or a Velpeau bandage. In persons over 40, the abduction

splint is likely to be necessary Neurologic or vascular complications, as evinced by paresthesia, paralysis, or circulatory embarrassment, require an abduction splint until the symptoms of nerve or vessel damage disappear and until abduction is free.

No full discussion of complicating fractures will be undertaken here. The commonest bony injury is that of fracture of the greater tuberosity. Reduction is carried out under anesthesia, just as for uncomplicated dislocation. The arm is then put up in sufficient abduction to secure the reposition of the avulsed tuberosity. An axillary triangle is often sufficient; it may be conveniently combined with a Velpeau bandage made with 3 inch elastic bandage well pinned at all intersecting points. Occasionally, an abduction splint is necessary. Active motion of the elbow and wrist begins at once. The shoulder can be carefully moved in ten days, and exercises begun in three weeks. Union is solid in five weeks.

Fractures of the humeral neck, complicated by dislocation, are best treated by reduction of the dislocation with traction, and immobilization in traction on an abduction splint, the arm being rotated to secure accurate apposition of fragments. The elbow is moved at once; the shoulder is moved in three to four weeks, depending on the severity of the injury and the accuracy of reduction. The abduction splint is necessary for about five weeks.

Prognosis. The prognosis varies with the patient's age: persons under 50 years have less than one month of disability and should have no residual disability; those over 50 have two to three months disability, on the average, and may have a residual limitation of abduction.

The percentage of patients suffering recurrent dislocation is exceedingly difficult to determine and the author finds no published data regarding it.

Vascular complications, if properly treated, do not change the prognosis of a dislocation. Brachial plexus injuries may occasionally be permanent, but in most instances will recover fully if treated in abduction; for medicolegal reasons, a careful record of evidence of nerve injuries is essential.

Avulsion of the greater tuberosity means a period of disability of six to eight weeks; fracture of the surgical neck, twelve weeks. Young persons will retain full mobility of the shoulder. After the age of 40, there is likely to be some limitation of abduction.

Recurrent Dislocations. With present methods of treatment, some persons suffering one shoulder dislocation will experience the same injury repeatedly thereafter as the result of slight, often trivial, violence. Reduction in these cases is readily accomplished, but permanent relief is a more difficult problem.

A great variety of operations have been proposed to prevent recurrent dislocation, but all have been supplanted to a large extent by the Nicola operation. This procedure consists of exposing the shoulder joint, dividing the long head of the biceps, and transplanting its tendon from the bicipital groove into a canal drilled into the head of the humerus. The result is a tendinous sling which prevents forward and downward motion of the humeral head, and dislocation cannot occur. The operation is notable for its successful end results with little or no limitation of motion as well as for its simplicity and safety. Epileptics are particularly subject to recurrent dislocations and can well be treated by the Nicola operation.

SUMMARY

1. Treatment of a dislocated shoulder involves diagnosis, anesthesia, reduction, and after-care.

2. The surgeon must protect himself with *x*-ray and written records of bone, nerve, and blood vessel injuries.

3. Brachial plexus anesthesia is a convenient, efficient, and safe method for controlling the pain of shoulder joint reductions.

4. Traction, either by Zierold's maneuver or by mechanical devices, is efficient in effecting reduction.

5. After treatment is important in obtaining good results; early active motion and exercises are advised.

6. Prognosis is better in younger individuals and in recent dislocations.

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ANALYSIS OF RESULTS FOLLOWING SYMPATHECTOMY FOR PERIPHERAL VASCULAR DISEASE*

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MATERIAL STUDIED

THIS report is based on a follow-up study of 105 sympathectomies done on fifty patients suffering from various types of peripheral circulatory disturbances.

TABLE 1

INDICATIONS OF SYMPATHECTOMY FOR PERIPHERAL VASCULAR DISEASE

1928–1936

Diagnosis	Selection of Cases
Raynaud's phenomena	Lack of marked structural changes
	Absence of sclerodactylia
	Stages 1 and 2
Buerger's disease	Absence of acute inflammatory stage
	Below 40 years of age with definite collateral reserve
	Poor response to conservative treatment
Poliomyelitis	Moderate paralysis limited to one extremity; evidence of vasospastic phenomena
	Age preferably between 6 and 10 years
Reflex dystrophy (causalgia, traumatic vessel spasm, Sudeck's atrophy).	Severe cases producing disability, resistant to physiotherapy, exhibiting abnormal vasomotor phenomena
Unclassified	Rapid onset of digital thrombosis with impending gangrene
	Mostly upper extremities involved

In the group diagnosed as Raynaud's disease (Table 1), a number of patients exhibiting Raynaud's phenomena due to secondary vessel spasm were first excluded. The diagnosis of Raynaud's disease was only arrived at by exclusion. In the typical forms, the stage of sclerodactylia with deep ulcerations was not subjected to operation, as our results in this group have been unsatisfactory. Operation for Raynaud's disease seemed most successful in the patient in whom organic obstruction of the digital arteries was absent or slight and in whom involvement of the skin, joints, and tendons had not yet taken place. Between these two groups there is a third, in which there is some organic damage, but dilatation of the vessels by reflex heat or vasodilators was still possible but incomplete. This group shows such improvement that operations are justified.

Operations on patients suffering from Buerger's disease have not been advocated in: (1) an acute inflammatory stage; (2) in a late stage with a closed collateral bed (frozen vascular tree); (3) patients past the age of 40; (4) if economic status permits a long rest in an even warm climate or if the cardiovascular apparatus is diffusely involved.

It is most difficult to argue for or against a sympathectomy in patients around 40 years of age who have had an acute arteritis in the early twenties, whose disease has been quiescent for many years and now present themselves with a second flare-up, usually in another previously uninvolved extremity. Such patients show little capacity for vasodilatation and show some sclerotic changes. They may have myocardial damage. In such cases, intensive conservative treatment together with paravertebral alcohol injection has arrested the disease in fifteen patients. This method should certainly be tried before sympathectomy in such borderline cases.†

† Paravertebral injections of alcohol as advocated by Reichert[1] have been done on twenty-five patients suffering from obliterating arteriosclerosis and are discussed elsewhere.[2]

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We have urged sympathectomy, however, in individuals between 20 and 40, who are having their first attack and who have a good capacity for vasodilatation. The result of the sympathectomy mainly depends on the stage of the disease, which may differ in each of the four extremities.

In case the upper extremity is involved, which is more frequent than suspected, sympathectomy is done as soon as nutritional changes, such as atrophy, ulceration or gangrene are manifest.

Following operation, the same conservative régime is instituted as preoperatively and is followed for many years.[3] This consists of complete abstinence from tobacco, increased fluid and salt intake, a series of typhoid vaccine injections twice a year and intermittent venous hyperemia treatments to stretch the venocapillary bed. This last method is more effective in the sympathectomized patient, where the resistance to stretch has been diminished.[4]

In poliomyelitic children, if they are younger than 8 years, if the paralysis is limited to one extremity and is moderate in degree, and if their extremities are cold, plum-colored and painful, if nodular patches of cyanosis, edema and chilblains are present, a sympathectomy will provide increased vascularity. An acceleration of growth, as reported by Harris[5] has not been observed in our cases.

In the fourth group, I have gathered a group of vasomotor and nutritional distubances, diagnosed as Sudeck's atrophy, traumatic osteoporosis, stump-neuroma, and causalgia and have called them reflex dystrophies.[6] Not only does the edema, cyanosis, and sensitivity to heat disappear, but bone may recalcify, as shown by Fontaine and Herrmann.[7]

A group of "unclassified" cases had to be established in this material. Some of the most dramatic successes have been obtained in this group without, however, establishing the possibility of a definite preoperative diagnosis.

ANALYSIS OF RESULTS

It is quite difficult to evaluate any method used in the treatment of peripheral vascular disease. Silbert[8] has recently pointed out that unless certain factors are eliminated, the value of any treatment must remain dubious. These factors are (1) the tendency to spontaneous improvement; (2) the effect of cessation of smoking; (3) the normal variations in vasoconstriction due to environmental changes in temperature and the patient's psychic state. To this one may add the effect of (1) rest in bed, (2) mild heat, (3) plenty of fluids, (4) regulation of the patient's diet, and (5) the surgical care of ulceration and necrosis. Obviously a complete elimination of all these factors in analyzing one form of therapy is almost impossible.

In trying to find out the place of sympathectomy in the treatment of peripheral vascular disease, further difficulties present themselves. A good result in Raynaud's disease means freedom from painful vasospastic attacks and softening of the sclerotic digits; but in patients suffering from Buerger's disease an arrest of the disease and the avoidance of amputation must be regarded as a good result even if a functional restoration to normalcy is an anatomic impossibility. That proper selection of cases, technically complete operations, avoidance of regeneration and adequate postoperative follow-up are important factors in obtaining good results has been pointed out elsewhere.[9]

In spite of the multiplicity of variables, an attempt has been made to evaluate the results of sympathectomy. It has been done by utilizing several methods. *First*, objective evidence has been sought that peripheral circulation has been modified by the operation. *Second*, in patients suffering from symmetrical lesions of approximately identical severity, one extremity was left for control over a period of several years. *Third*, the total material of 105 sympathectomies performed on fifty patients suffering from various types of peripheral vascular

disease has been followed for at least two years and the results tabulated according to criteria to be discussed.

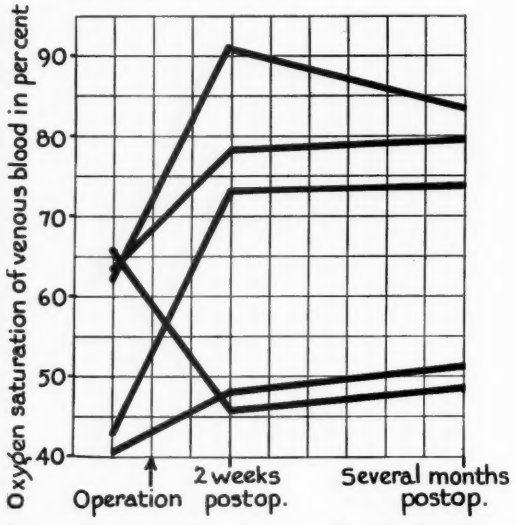

FIG. 1. O_2 saturation of venous blood taken from the femoral vein before, two weeks and several months after sympathectomy. Note the marked rise in the first three instances, a moderate rise in the fourth and a definite drop in the fifth case. This last patient developed a popliteal thrombosis following operation which, however, did not result in gangrene.

THE MODIFICATIONS OF CIRCULATION FOLLOWING SYMPATHECTOMY

The blood vessels of the sympathectomized limb react to direct application of heat and cold and also to ischemia in the normal manner.[9] But, being deprived of their vasomotor innervation, these vessels are freed of a number of extrinsic and intrinsic stimuli, which arrive to the vessels over the efferent sympathetic pathways. Thus cooling or pinching the body,[10] pain, fright or anger[11] do not produce vasoconstriction in the sympathectomized extremity, nor will heating the body[12] or the production of fever with typhoid vaccine[13] produce vasodilatation. The question arises, how important are these factors in regulating circulation? When studies in blood flow are made with a modified Hewlett-van Zwaluvenburg method, it becomes apparent that great fluctuations in blood flow are produced by the stimuli enumerated above. Sympathectomy abolishes these fluctuations. In a recent study of some of my patients, Gellhorn and Steck[19] found that the inhalation of CO_2, which normally produces a marked central vasoconstriction of peripheral vessels, is abolished in the completely sympathectomized extremity and may even give rise to a paradoxical vasodilatation as the local vasodilating action of CO_2 may now become manifest. This method may serve as an index for the completeness of sympathetic denervation.

Another effect of a permanent vasomotor palsy can be detected by the study of blood gases, notably the oxygen saturation of the venous blood (Fig. 1) draining the sympathectomized extremity. Detailed figures have been presented elsewhere.[9] A simple graph illustrates some data obtained on four patients by Dr. F. K. Hick, all of whom had arterial and venous (femoral) punctures before, shortly after and several months after the operation. The degree of the rise depends on available collaterals and corresponds closely with the clinical improvement. In one case shown here, the oxygen saturation dropped from 66 per cent to 47 per cent. An explanation of this was found in an acute popliteal thrombosis following the operation, which, however, did not result in gangrene.

THE CLINICAL COURSE OF THE DISEASE IN UNILATERAL SYMPATHECTOMIES

Sympathectomy according to our present knowledge does not remove diseased structures. While some authors have reported inflammatory or degenerative changes in the ganglia removed from Raynaud's disease or Buerger's disease, other studies, notably those of Craig and Kernohan,[14] revealed no pathologic changes. Our material has been studied with neurohistologic methods by Dr. Hassin, who has never reported any abnormal histologic findings. The vasomotor palsy which is obtained by sympathectomy has a favorable effect on the circulation of an affected limb even though it does not strike at the cause of the disease. There are eight patients in this series, who either purposely or uninten-

tionally have one denervated extremity, while the other one has been left alone or sympathectomy has been incomplete. The operated side has usually been more involved by the disease process than its fellow.

Six of these patients suffer from Raynaud's disease. The operated side is completely dry, warm and the texture of the skin is looser. Color changes may still occur, chiefly at the tips of the digits, but are not painful. The burning on release of

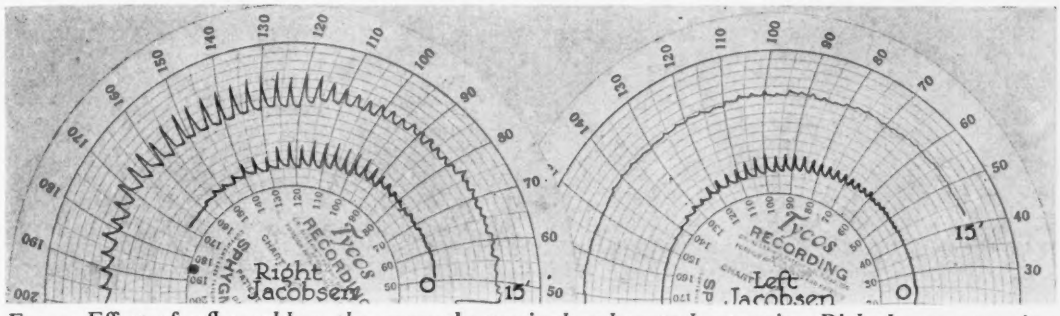

Fig. 2. Effect of reflex cold on the sympathectomized and control extremity. Right lower extremity sympathectomized several months previously. Note marked vasoconstriction in the control extremity in contrast with paradox increase in pulsation on right side. This increase is due to the systemic rise in blood pressure which followed the immersion of both hands in ice water.

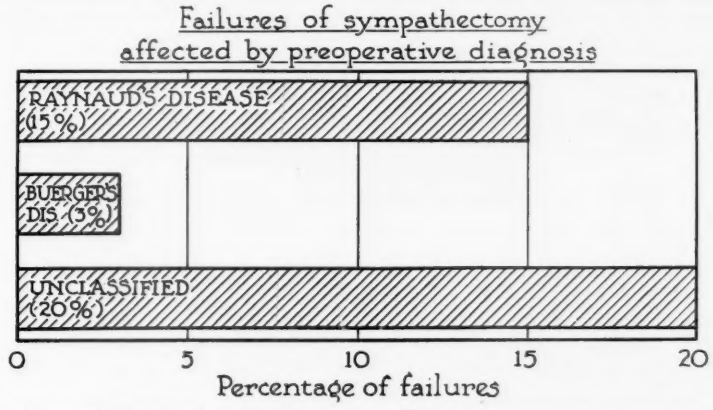

Fig. 3. Failures of sympathectomy affected by preoperative diagnosis. Note that Raynaud's disease shows a failure of 15 per cent which is partly due to incomplete operations and partly to the fact that most of these were cervicodorsal sympathectomies which give notoriously poor results. The unclassified group shows the largest percentage of failures because most of them are probably not of vasospastic origin. (See also Table IV.)

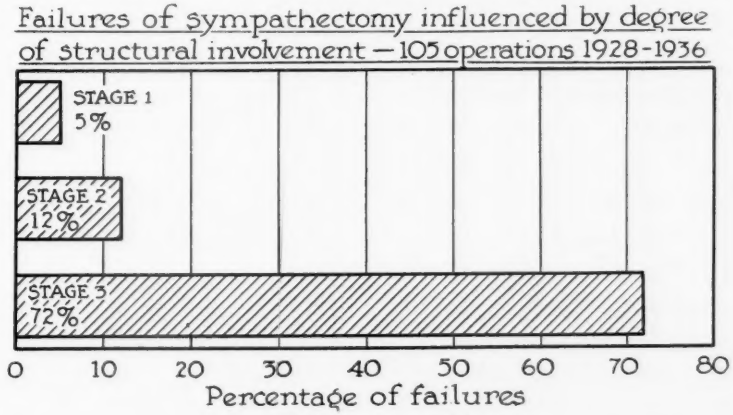

Fig. 4. Table III in graphic form.

the spasm is absent. The control side sweats profusely, spasms occur on emotional stimuli or environmental changes; standstill. In another patient, who had lost both feet before coming under observation, one upper extremity has been sympathec-

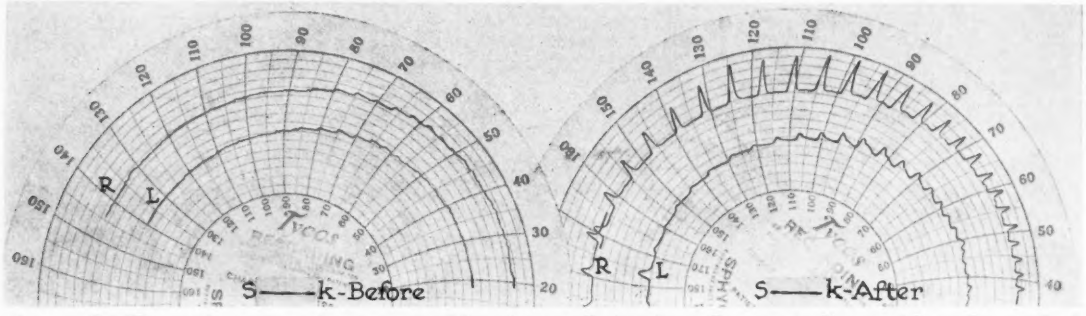

FIG. 5. Oscillometric curves of a 21 year old patient suffering from Buerger's disease. Note the marked opening of the vascular bed fifteen minutes after the intravenous injection of sodium nitrite on the right side. The left side hardly responded to the vasodilator. This patient's right foot is in an earlier stage of disease than the left; better results may be expected from sympathectomy on this side.

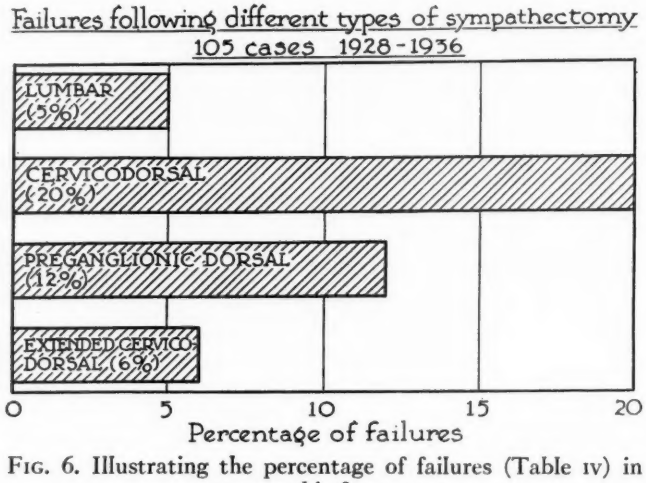

FIG. 6. Illustrating the percentage of failures (Table IV) in graphic form.

the sclerodactylia slowly progresses; small ulcers heal slowly or not at all. The same picture is true of the incompletely sympathectomized extremity. Patients who are well selected invariably request operation on the control side at an early date.

Two patients suffering from Buerger's disease have had unilateral lumbar sympathectomies. In both instances the side which was far more affected and had shown ulceration was operated upon. In one patient who has now been followed for three years and has been getting all the benefits of conservative treatment, the sympathectomized limb is now warmer, the ulcer is healed and his walking ability could be improved by intermittent venous hyperemia. The other extremity is at a tomized; in that hand there were multiple ulcers and continuous pain, both of which were favorably influenced. The control side, in spite of all conservative treatment is slowly progressing. These patients are especially mentioned because the argument that conservative measures used in conjunction with sympathectomy might have been the cause of improvement cannot hold here.

As pointed out before, sympathectomy inhibits the fluctuations of vasomotor tonus; these fluctuations are intensive enough to elicit a mechanism which sympathectomy abolishes in Raynaud's disease. In Buerger's disease (Fig. 2), however, there is only infrequent evidence of acute vasospastic phenomena; there seems to be

a more chronic continuous sympathetic stimulation originating reflexly from segmental thrombi. Such a reflex vasoconstriction can be interrupted by local excision of thrombosed vessels, by a spinal anesthetic or by a sympathectomy.[6] The last, of course, is the most feasible and permanent.

ANALYSIS OF THE WHOLE MATERIAL

Only patients operated on before the end of 1936 have been included. (Table II.)

TABLE II
RESULTS OF SYMPATHECTOMY FOR PERIPHERAL CIRCULATORY DISTURBANCES
1928–1936

Diagnosis	No. of Patients	No. of Operations	Success	Improvement*	Failure	Mortality
Raynaud's disease.	10	26	17	4	5	
Buerger's disease..	21	56	49	4	2	1
Poliomyelitis with vessel spasm....	3	3	3			
Reflex dystrophy (causalgia, osteoporosis).....	10	10	10			
Unclassified.....	6	10	7	1	2	
Total.....	50	105	86	9	9	1

* Improvement indicates definite amelioration of symptoms but not complete relief. Failure indicates that the disease had either progressed or remained at its preoperative state. The only death occurred five days after lumbar sympathectomy, due to coronary thrombosis.

Of the many variables, I have picked three factors for analysis, and the results have been tabulated accordingly.

The *preoperative diagnosis* modifies the obtained results in that there is the largest percentage of failures in the unclassified group, still a considerable percentage in Raynaud's disease and very encouraging results in Buerger's disease. (Fig. 3.) This rather startling result is explained first of all by the fact that most operations in the unclassified group and in Raynaud's disease were on the upper extremity which is notoriously more difficult to denervate, and secondly by the very rigid criteria which are used to determine the operability of Buerger's disease. Also the unclassified group will gradually be eliminated by a definite etiologic diagnosis and will form a part of the non-operative group in the future.

The *stage of the disease* in which the operation is undertaken (Table III) and

TABLE III
FAILURES OF SYMPATHECTOMY INFLUENCED BY DEGREE OF STRUCTURAL INVOLVEMENT
(105 Operations 1928–1936)

Stage	Criteria	No. of Operations	Failures, Per Cent
1	No structural disease Vessels dilate fully	22	5
2	Moderate structural changes Incomplete capacity for vasodilation	76	12
3	Advanced structural changes* Minimal capacity for vasodilatation	7	72

* Note that in Group 3 the percentage of failures is 72. Obviously operations in this group are justified only in an attempt to save the leg from amputation. Note also that most patients belong to the second group.

the spontaneous course of the disease at the time and following the operation are important factors in the end results. (Fig. 4.)

TABLE IV
TYPE OF OPERATION AFFECTING RESULTS

Operation	No. of Operations	Failures*
Lumbar sympathectomy.....	40	2 (5 per cent)
Cervicodorsal sympathectomy	25	5 (20 per cent)
Preganglionic dorsal sympathectomy.....	24	3 (12 per cent)
Extended cervicodorsal sympathectomy.....	16	1 (6 per cent)
Total.....	105	11 (10 per cent)

* Failure of sympathectomy: no change from preoperative status or progress of deterioration. Note that lumbar sympathectomy and the extended cervicodorsal sympathectomy have the lowest percentage of failures.

Patterson Ross[15] has classified Raynaud's disease into three groups and I believe that this could be done for all peripheral circulatory disturbances. According to the predominance of the vasospastic against the structural element, the success of sympathectomy in the different groups is striking. In the first stage there is no or

very little detectable change in the arteries or in the soft tissues of the digits. (Fig. 5.) The vessels dilate fully when heat is applied reflexly, when the sympathetic fibers are blocked with novocaine or when sodium nitrite is injected intravenously. In the second stage there is ulceration of the tips of digits or painful stellate scars. The vessels show capacity for vasodilatation but it comes on slowly and is incomplete. In the third stage patients have advanced structural disease of the arteries. The vessels only have a minimal or no capacity to dilate. The soft tissues are atrophic or sclerotic and the tips of the digits are ulcerated or gangrenous.

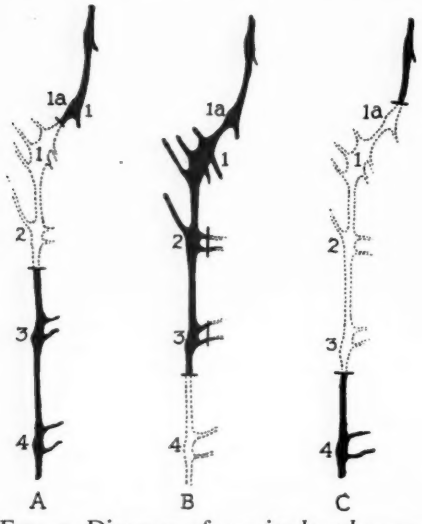

Fig. 7. Diagram of cervicodorsal sympathetic chain. 1, stellate ganglion. 1*a*, intermediate ganglion, 2, 3, and 4, second, third and fourth dorsal ganglia. A, cervicodorsal sympathectomy. B, preganglionic sympathectomy. C, extended cervicodorsal sympathectomy. This last operation has given us results in sixteen cases which are comparable to those obtained by the lumbar sympathectomy.

Most patients both in private and dispensary practice belong to the second and third group. The first group may not see a surgeon nor is it easy to determine that arrest of the disease might not take place. In this group conservative measures carried out for a sufficiently long time, give one an insight into the spontaneous course of the disease. Obviously operations in the third group are only justified in an attempt to save the leg from amputation. Unless a surgeon is thoroughly familiar with the course of peripheral vascular disease, its remissions and exacerbations, he will operate either too often or not often enough.

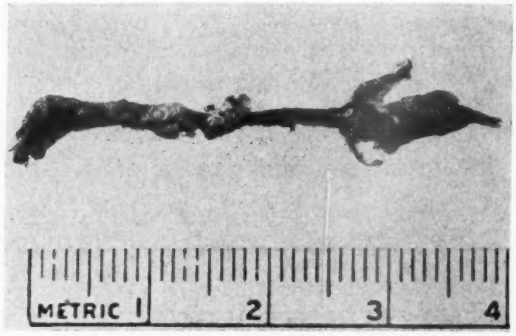

Fig. 8. Extended cervicodorsal sympathectomy performed through the anterior, supraclavicular approach. The chain was cut above the stellate and below the third dorsal ganglion.

The type of operation performed is the third and last factor (Table IV) we have analyzed. Lumbar sympathectomy, in the consensus of all workers (Fig. 6), has always given superior results to sympathectomies done for the upper extremities. As shown in the graph, lumbar sympathectomies, most of which were done for Buerger's disease, poliomyelitis or causalgic syndromes, have been quite successful. The cervicodorsal sympathectomies have been done in three different ways. (Fig. 7.) The diagram to the left illustrates the removal of the stellate ganglion; the dorsal chain is sectioned below the second thoracic ganglion. This is Adson's method except that a cervical approach is used in my clinic. The diagram in the middle shows the principle of the preganglionic sympathectomy as advocated by Telford. The sympathetic chain is cut below the third ganglion, and the third and second white rami are cut. This would leave the postganglionic fibers intact. It is stated by J. C. White[16] that such postganglionic degeneration which occurs after a typical cervicodorsal sympathectomy is the cause of recurrent spasms in Raynaud's disease as the vessels are now sensitized to epine-

phrine. The diagram to the right shows my present method in which the excision is extended upward to include the intermediate ganglion or if this is invisible to strip the vertebral artery and caudalward it includes the third thoracic ganglion. (Fig. 8.) My results with this last type have been better than with the preganglionic method, which does not cut the important first white ramus,[17] so that some sweating remains in the hand. Since the recurrence in Raynaud's diseases following operation occurs within six months or a year and sensitization phenomena appear six to eight days after operation,[18] the sensitization cannot be considered a sign of recurrence in the postganglionic sections.

The completeness of the operation either on the lower or on the upper extremity can be demonstrated by Minor's starch-iodine or Grace Roth's cobaltous chloride test. A very accurate and numerical expression of the completeness of sympathectomy can be obtained by determining the resistance of the skin to the galvanic current. This will rise enormously after sympathectomy from 50 to 70,000 ohms to 300,000 ohms or more. (Fig. 9.) For practical purposes,

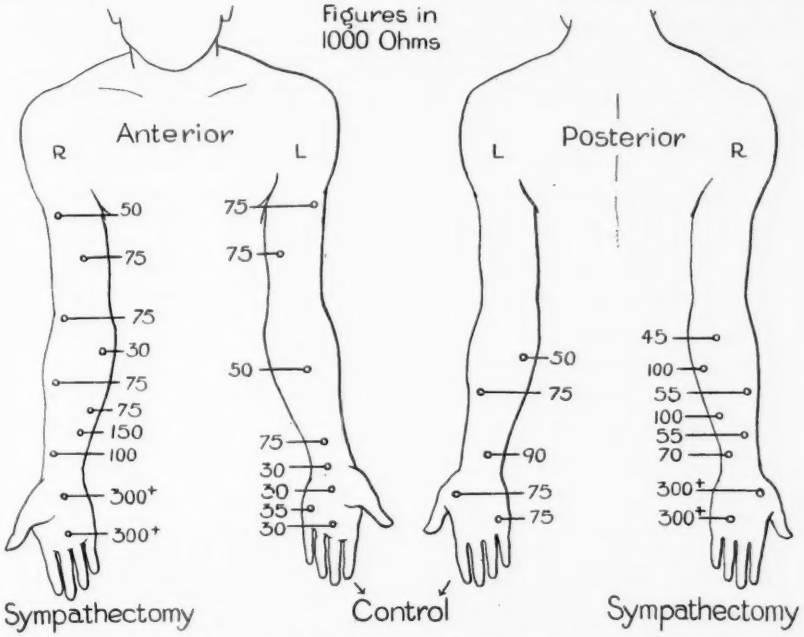

Fig. 9. Determinations of galvanic skin resistance on the control and on the sympathectomized side. Note that on the palmar surface of the operated hand the skin resistance rises above 300,000 ohms. Note also that on the ulnar surface the readings are equally high, indicating a complete operation. The skin resistance on the lower and upper arm did not seem to rise at all.

however, the palpating finger can readily detect a strip of moisture on the sympathectomized limb. On the upper extremity this moist strip is usually of ulnar distribution, on the lower it follows the femoral or saphenous nerve. This has led us to take special care in removing all of the second and preferably the third thoracic ganglion on the upper extremity and the second or even first lumbar ganglion for the lower extremity.

This technical discussion is important because of my conviction that failures, at least in this material frequently occur in insufficiently sympathectomized limbs. A completely dry hand has not ever become moist—the longest observation being eight years. But a slight area of perspiration left on a sympathectomized limb will grow as if regeneration could occur from an overlooked fiber. In evaluating results this point requires consideration.

SUMMARY AND CONCLUSIONS

As a result of this study it is felt that sympathectomy has a definite place in the treatment of peripheral circulatory disturbances. The results are influenced by the type and extent of the disease, by the natural course of the disease, by the extent of the operation and some other factors which elude statistical analysis and have to be determined in the individual case. Sympathectomy should be undertaken by men who are fully familiar with peripheral vascular syndromes, their natural course and their response to other forms of therapy. Undertaken under such conditions sympathectomy shows an increasing percentage of successful results.

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THE SURGICAL TREATMENT OF CARCINOMA OF THE PANCREAS

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WITH the technical developments which in the past few years have made possible radical resection of carcinomas of the pancreas, with the discovery of vitamin K and its clinical application in the control of the bleeding tendency in obstructive jaundice, and finally with improved preoperative and postoperative management of jaundice, there has been an increased interest in the surgical treatment of carcinoma of the pancreas. Operations which five years ago would have entailed too much risk to justify their performance can now be carried out with relative safety. What is now required is a means for the recognition of carcinoma of the pancreas in the stage where it is still amenable to surgical excision.

Carcinoma of the pancreas does not differ in any essential way from carcinoma in other organs. It begins as a localized lesion and in a reasonably high percentage of cases it is a slow-growing, well-differentiated tumor. Metastases are present in a large number of the cases, mainly because the carcinoma gives few symptoms in its early stages and is therefore recognized late in its clinical course. Like carcinoma of the thyroid gland, no alarming symptoms are observed by the patient until the disease has progressed to such an extent that vital structures are invaded.

Again, like carcinoma of the thyroid, carcinoma of the pancreas gives definite premonitory symptoms which, if properly interpreted, will lead to earlier recognition and more effective treatment. Relatively early in the course of the disease, patients with carcinoma of the pancreas often experience symptoms of sufficient severity to bring them to the physician and it is the physician who may be at fault for not interpreting these symptoms correctly. In the past the physician has been loath to make a diagnosis of carcinoma of the pancreas because of the uniformly hopeless prognosis in this disease. Recognition of carcinoma of the pancreas and confirmation of the diagnosis by exploratory operation have been equivalent to the signing of the death warrant. But now that early recognition of this lesion offers the possibility of a surgical cure, it is essential that we utilize every means at our disposal to confirm the diagnosis.

DIAGNOSIS

In approximately 30 per cent of the cases of carcinoma of the pancreas in the Cleveland Clinic series, jaundice has not been present at the time of the patient's death or at the time of confirmation of the diagnosis by exploratory operation. In many of these cases the disease apparently originated in the body or in the tail of the pancreas. Pain was the most common symptom in this group of cases, was usually referred to the epigastrium, and was of a constant, deep, boring, quality; it was unrelated to meals and was present at night as well as in the daytime. In a smaller group of cases metastasis to distant points (brain, vertebrae, sternum, etc.) was the leading finding.

The prognosis in these cases of carcinoma of the pancreas without jaundice in which the tumor originates in the body of the organ or in such a location that the common bile duct is not involved, is nearly certain to be unfavorable. The disease does not manifest itself until extension or metastases involve vital structures at which time the possibility of cure is

past. It is in the highly differentiated, slowly growing tumors of the head of the pancreas that the common bile duct becomes obstructed and the diagnosis can be established before the disease has progressed beyond the stage of curability.

Although the development of jaundice has long been considered to be the cardinal sign of carcinoma of the pancreas, an analysis of any group of cases will show that, in a high percentage, symptoms are present for some time prior to the onset of the jaundice. These "prodromal" symptoms consist of anorexia, weakness, fatigue, loss of weight, and vague distress in the epigastrium; these were present in 72 per cent of the cases in this series and antedated the jaundice by from one to ten months. These symptoms were usually of sufficient severity to bring the patient to a physician, but in only a small percentage of the cases was the correct diagnosis suspected until jaundice appeared. It is in this group of cases that the diagnosis often can and should be established earlier.

If a man beyond the mid-period of life suddenly and unaccountably begins to fail in weight and strength and if marked anorexia and vague epigastric distress are present, carcinoma of the pancreas should be suspected. If careful clinical, Roentgen, and laboratory studies fail to reveal any cause for the patient's symptoms, if there is no psychic background for the complaints, and if rest and diet do not result in a prompt and striking improvement, an exploratory operation to determine whether early carcinoma of the pancreas is present should be advised.

The development of these "prodromal" symptoms of carcinoma of the pancreas coincides, in all probability, with the occlusion of the pancreatic duct by the tumor. Since the pancreatic duct is occluded within the substance of the gland, the disease is still potentially curable by resection of the head of the pancreas. It is at this stage of the disease, before the onset of jaundice, that the best surgical results will be obtained.

Although severe pain occurred in only 36 per cent of the cases of carcinoma of the pancreas in this series, a vague distress in the epigastrium, usually coming on at the onset of the "prodromal" period, was a common complaint. Intermittent occlusion of the pancreatic duct no doubt gives rise to painful sensations and to reflex disturbances of the gastrointestinal tract just as an intermittent hydronephrosis may cause pain and gastrointestinal symptoms. When the occlusion has become complete, the pain as a rule subsides and does not recur until the carcinoma invades the surrounding structures.

In addition to the presence or absence of pain, several points are of value in differentiating carcinoma of the pancreas from a stone in the common duct. The age of the patient is not of much value, the average age of patients with stones in the common duct being 52 years as compared with 56 for carcinoma of the pancreas. In this series a higher percentage of patients under 40 years of age had carcinoma of the pancreas than choledocholithiasis.

Carcinoma of the pancreas is predominantly a disease of men; only 16 per cent of the cases in this series occurred in women.

The depth of the jaundice and the continuity of the jaundice after its initial appearance are important factors in differentiating the two conditions. In no case of carcinoma of the pancreas did the jaundice disappear after it was once established, whereas intermittent jaundice accompanied often by chills and fever was a common finding in the presence of choledocholithiasis. Fever was rarely associated with carcinoma of the pancreas, and when present was indicative of extensive metastasis.

In the patients with carcinoma of the pancreas, the jaundice was usually very deep as a result of complete obstruction of the common bile duct. In this group of cases the icterus index averaged 100 units

as compared to 45 for the cases with calculi in the common duct. Unless the patient is seen during the first few days of the jaundice, icterus indices of less than 50 are rare in carcinoma of the pancreas. Pruritus tends to be more marked in carcinoma of the pancreas and may occur before the patient notices the jaundice.

In 90 per cent of the cases of carcinoma of the pancreas having jaundice, the liver is palpably enlarged, usually as a result of biliary obstruction rather than metastasis and this enlargement is more marked than is usually found in the incomplete obstructions associated with choledocholithiasis. Only 27 per cent of the patients with common duct stones had a palpable enlargement of the liver.

Courvoisier's law, although often inaccurate before operation as a result of difficulties experienced in palpating the gall-bladder through a thick abdominal wall, holds surprisingly true when judged by the operative findings. Gallstones will be found in approximately 20 per cent of the cases of carcinoma of the pancreas and in about half these cases the gall-bladder will be contracted as a result of inflammation from the stones. In another small group of cases, previous operations (cholecystostomies, etc.) will have resulted in contraction of the gall-bladder. In a third small group of cases, the carcinoma will be so extensive that the cystic duct as well as the common duct will be occluded by the tumor, and under these circumstances the gall-bladder will not be dilated. With the exception of these three groups, Courvoisier's law was found to hold true in all cases in this series, the gall-bladder being dilated in 69 per cent of the cases of carcinoma of the pancreas. The gall-bladder was dilated in only one case of stone of the common duct and in this case the head of the pancreas was extremely hard and the presence of a carcinoma could not be ruled out.

In the presence of complete obstruction of the common bile duct, duodenal drainage gives no information except the negative fact that no bile is coming through—a point indicating the presence of malignancy. If cholesterol crystals are recovered in the duodenal bile the presence of a stone in the common duct is suggested.

PREOPERATIVE MANAGEMENT

An analysis of the causes of death following operations performed on patients with obstructive jaundice shows that the most dangerous complication is postoperative hemorrhage, this complication alone having been a factor in one-third of the postoperative deaths. Until recently we have had no reliable method of determining the presence of a hemorrhagic tendency and no effective method of correcting it. Routine laboratory methods for the determination of bleeding and clotting time have been of no value. The Lee White method, dependent on the coagulation time of venous blood, has been of limited value. The only reliable method of recognizing a hemorrhagic tendency is by the prothrombin clotting time of Quick.[1] This subject has been discussed in detail in a previous publication.[2]

The bleeding tendency in jaundice is the result of a deficiency of prothrombin. Normally this substance is present in the plasma in approximately five times the quantity necessary to insure normal coagulation. Little or no change in the coagulation of the blood is noted until the prothrombin falls to 20 per cent of its normal level, but when it falls below this point a marked hemorrhagic tendency appears. This hemorrhagic tendency can be diagnosed with accuracy by the prothrombin clotting time.[1]

It has been well established by both animal and clinical investigations that the lowered prothrombin levels and the hemorrhagic tendency in obstructive jaundice are the result of a failure in the absorption of vitamin K from the intestinal tract. This substance is a fat soluble vitamin and is not absorbed unless bile is entering the intestinal tract. Butt and Snell[3] have clearly shown that, when

vitamin K and bile salts are given to patients with obstructive jaundice, the hemorrhagic tendency is corrected and the

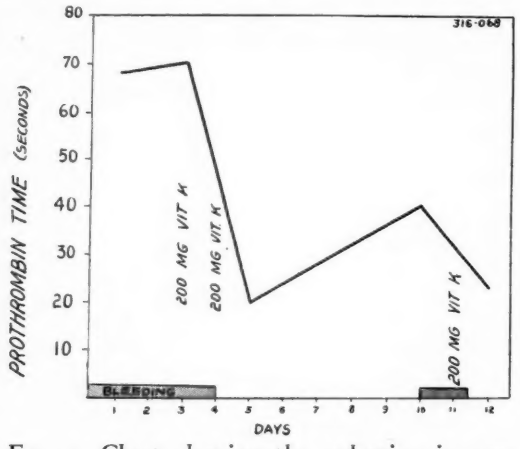

Fig. 1. Chart showing the reduction in prothrombin clotting time and cessation of bleeding following the administration of vitamin K.

prothrombin clotting time falls to normal levels. Figure 1 indicates the response of the prothrombin clotting time of a jaundiced patient to the administration of vitamin K and bile salts. Prior to the administration of vitamin K the patient had been bleeding from the incision, from the gastrointestinal tract, from the uterus, and from all mucous membranes. Within twelve hours after the oral administration of 200 mg. of vitamin K all bleeding stopped and the patient went on to recovery. As Butt and Snell have emphasized, it is essential that the bile salts be given with the vitamin K in order to insure its absorption.

In view of the importance of hemorrhage as a postoperative complication in patients with obstructive jaundice and in view of the effectiveness of vitamin K in the prophylaxis and treatment of hemorrhage, it is clear that operation should never be performed on jaundiced patients unless the prothrombin clotting time is normal or has fallen to normal levels in response to treatment with vitamin K.

The second consideration in the preoperative preparation of the jaundiced patient is the status of the liver. In order to insure the best possible liver function, the diet should be high in carbohydrates and in total calories. In addition a 10 per cent solution of glucose should be given intravenously each day for several days until the glycogen reserve of the liver is restored.

Calcium gluconate given intravenously may be of value in the control of the pruritus but is not effective in the control of hemorrhage.

Prior to the development of vitamin K, a preoperative transfusion of blood was considered essential in jaundiced patients. The administration of normal blood served to raise the prothrombin above the critical level and was helpful in preventing hemorrhage. Transfusion before operation is no longer essential unless the patient is anemic but it should be remembered that blood transfusion is still the most rapid means available for raising the prothrombin level and correcting a hemorrhagic tendency.

OPERATIONS FOR CARCINOMA OF THE PANCREAS

Operations for carcinoma of the pancreas can be divided into three groups—exploratory, palliative, and curative.

In the first group the abdomen is explored and the diagnosis is confirmed without any attempt being made to relieve the patient's symptoms.

Cholecystostomy is the least effective of the palliative operations. By the establishment of an external biliary fistula the jaundice and pruritus are relieved but no provision is made for the restoration of the bile to the intestinal tract. The patient continues to fail to assimilate nourishment and the course is rapidly downhill to a fatal termination. A hemorrhagic tendency often develops and the care of the biliary fistula is an additional burden to the patient and his relatives.

Cholecystogastrostomy or cholecystoduodenostomy are the best of the palliative operations for carcinoma of the pancreas. They have the advantage of reëstablishing the continuity of the flow of bile and abolishing the annoying pruritus. Striking

subjective and objective improvements in the general condition of the patient often follow. Cases have been reported in

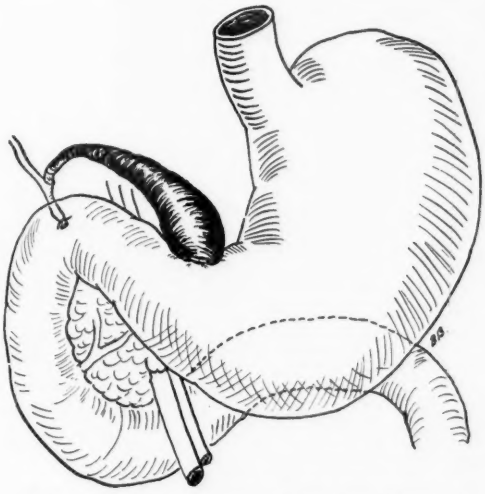

Fig. 2. First stage of radical resection of the head of the pancreas. Figure shows common duct ligated and gall-bladder anastomosed to the stomach.

which patients with proved carcinoma of the pancreas have lived nearly five years in relative comfort after this type of palliative operation. One patient in this series lived three years, eventually dying from carcinoma. This type of operation has the additional advantage of providing a permanent cure in the occasional case in which the obstruction of the common duct is caused by an inflammatory lesion rather than a carcinoma.

In this series the postoperative mortality rate was actually 7 per cent lower in the cases in which anastomoses between the biliary tract and the gastrointestinal tract were made than in the cases in which exploration only or exploration and cholecystostomy were performed. By reintroduction of the bile into the intestinal tract, the bleeding tendency was apparently overcome and late hemorrhage was avoided. The incidence of postoperative bleeding was only one-fourth as high in the patients subjected to anastomosing operations as in those who were merely explored or in whom only a cholecystostomy was done.

For these reasons, in treating patients with jaundice secondary to carcinoma of the pancreas, we prefer, whenever

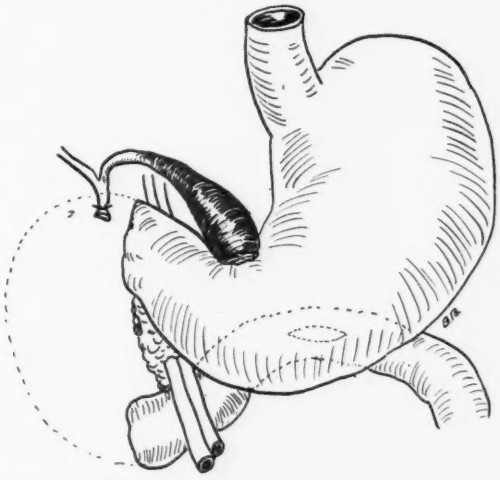

Fig. 3. Second stage of radical resection of the head of the pancreas. Figure shows common duct and cholecystogastrostomy performed at the first stage. In addition, the stomach has been severed at the pylorus and the proximal end inverted. The duodenum and head of the pancreas have been removed and the distal end of the duodenum has been inverted. A posterior gastroenterostomy has been performed.

possible, to anastomose the biliary and intestinal tracts.

The third type of operation for carcinoma of the pancreas is the operation of choice in the early case. We are still handicapped by our failure to establish the diagnosis early enough to make this type of operation widely applicable. Yet autopsy statistics indicate that in approximately 10 per cent of the cases of carcinoma of the pancreas and in a considerably higher percentage of the cases of carcinoma of the bile ducts and ampulla of Vater the carcinoma has not metastasized at the time of the patient's death.[4]

The radical operation for carcinoma of the pancreas as described by Whipple[5] consists of a block resection of the duodenum, head of the pancreas, and adjacent fatty and areolar tissue. It is based on sound principles of cancer surgery and has already yielded encouraging results in a limited series of cases. Of the twelve cases

reported in the literature, six patients have survived the operation and one of these (reported by Whipple) is alive and well nearly three years after operation. I have recently reported a thirteenth case in which the patient is well six months following resection of the pancreas for carcinoma.* (Fig. 3.)

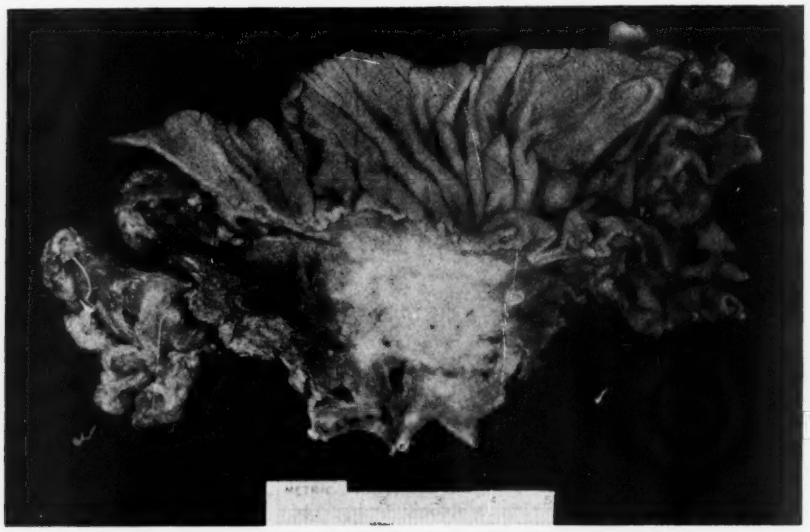

Fig. 4. Gross specimen of carcinoma of the pancreas surgically removed. Patient alive and well six months after operation.

If the jaundice is of long duration and the liver function is impaired, the first stage (cholecystogastrostomy and ligation of the common duct, Fig. 2) should be performed under local anesthesia, using a splanchnic block. Since there is no great need for relaxation, the first stage of the operation can easily be performed under local anesthesia without subjecting a poor risk patient to unnecessary anesthetic hazards.

The cholecystogastrostomy stoma should be made an inch or more in diameter in order to assure the maintenance of an adequate stoma after the contraction of the gall-bladder. A stricture at this point may result in the development of an ascending biliary infection. The second stage of the procedure will be facilitated at this time by ligation of the common duct with a black silk tie.

Exploration of the common duct and of the pancreas should always be performed at the time of the first stage. The duct is usually dilated to such a degree as to allow the insertion of the index finger and the obstructing lesion can be palpated from within the duct. Metastasis should be searched for and the degree of fixation of the tumor judged. A satisfactory method of palpating the head of the pancreas is by inserting the left hand behind the pancreas in the foramen of Winslow and palpating the organ bimanually, the right hand lying on the mesocolon over the head of the pancreas. The pancreas should not be exposed at this stage lest adhesions thus produced render the second stage more difficult.

The second operation (Fig. 4) should be performed as soon after the first as the patient's general condition permits, but a minimum of two weeks should be allowed for convalescence. Excellent exposure for this stage can be obtained through a transverse epigastric incision. A general anesthetic is recommended in order to insure adequate relaxation. Exposure of

* Since the writing of this paper, the patient referred to has died as a result of contracture of the cholecystogastrostomy stoma. There was no gross evidence of metastasis or local recurrence of the tumor, but, microscopically, early carcinomatous change was noted in the epithelium of the bile ducts throughout the remaining portion of the pancreas. The stoma was over an inch in diameter at the time of operation, a fact which emphasizes the point that the stoma cannot be made too large.

the region of the pancreas is obtained by diversion of the gastrocolic omentum. The stomach is then divided at the pylorus and the proximal end closed. Silk is recommended as a suture material because if pancreatic juice should escape, catgut may be digested. The duodenum is next mobilized and the gastroduodenal artery ligated. No attempt is made to separate the duodenum from the pancreas, the dissection being carried along the lateral and posterior aspects of the duodenum. The duodenum is again divided distal to the head of the pancreas and its distal end closed. The hand can then be inserted behind the duodenum and the head of the pancreas and these structures are lifted forward in a block.

Palpation of the pancreas will now show the extent of the tumor. A blunt instrument can be inserted beneath the body of the pancreas well distal to the tumor and the pancreas can be divided. The pancreas itself is not very vascular but underlying it are the portal, splenic, and superior mesenteric veins which receive small tributaries from the pancreas and render this portion of the dissection difficult.

The cut end of the pancreas can best be ligated by three mattress sutures of stainless alloy steel wire passing through the entire pancreatic substance and with the central suture so placed as to encircle the duct completely. The external secretion of the pancreas is not essential to the life or health of the patient. The operation is completed by a posterior gastroenterostomy to reëstablish the continuity of the gastrointestinal tract. (Fig. 4.) The pancreatic bed should be drained for three or four days, two cigarette drains being sufficient for this purpose.

In Whipple's most recent publications he has favored a more elaborate cholecystointestinal anastomosis carried out on the Roux principle. By this means he hopes to decrease the incidence of postoperative cholangitis. It is my impression, however, that the greatest hazard is at the first stage when the patient is deeply jaundiced, poorly nourished, and in a critical condition. I therefore favor the simplest operation which will allow bile to enter the intestinal tract and I believe that if the cholecystogastrostomy stoma is made large enough to prevent formation of a stricture, cholangitis of a serious degree will not occur.

Palpation of pancreas containing a carcinoma at the head may give a mistaken impression as to the extensiveness of the lesion. The pancreatic duct is often completely occluded and proximal to the point of occlusion it is enormously dilated and filled with fluid. The pancreatic tissue is flattened to a shell around the tensely dilated duct and palpation of the pancreas suggests that the entire organ is hard and involved in the tumor. Careful palpation, however, reveals a difference in the stony hard consistency of the tumor in the head and of the tense slightly fluctuant body of the pancreas. If doubt exists, a small needle can be inserted into the duct and the fluid aspirated so that the true extent of the tumor can be better ascertained.

POSTOPERATIVE TREATMENT

Operations performed in the presence of jaundice carry with them the added risk of the development of liver failure. This risk varies directly with the duration of the jaundice and the degree of liver damage. It is reduced by avoiding a prolonged general anesthesia and by the preoperative administration of glucose solution and a high carbohydrate diet. The most critical period, however, comes after the operation and at this time, when the patient is unable to take food and fluids by mouth, it is most important to protect the liver by the intravenous administration of large quantities of glucose solution.

We have demonstrated clearly in hyperthyroidism that glucose given intravenously by the continuous drip method is much more effective in controlling the postoperative thyroid reaction than is the

intermittent administration of large quantities of glucose solution. When the glucose is given intermittently it is usually given too rapidly and a great deal of it is eliminated by the kidneys. The same applies in obstructive jaundice; if the maximum assimilation of the glucose is to be obtained and the liver is to be given maximum protection, the glucose should be given continuously.

In a recent case of obstructive jaundice the patient began to hiccough on the second postoperative day and on the third postoperative day he became confused and delirious. His condition appeared desperate, blood transfusion was given in order to prevent any tendency to bleed, but it was not until a continuous drip of glucose was given intravenously that the delirium cleared. The hiccoughs finally ceased, the liver again began to function, and the bile, which had been pale and had been excreted through the T-tube in very small amounts, rapidly returned to normal quality and quantity. This patient was practically afebrile during the period of his delirium and there was no evidence of pulmonary or intraperitoneal complication. The toxic reaction was certainly the result of liver failure and the dramatic recovery was in all probability directly attributable to the administration of large quantities of glucose intravenously and continuously.

A second complication of surgery in the biliary tract is the development of cholangitis, a complication which has occurred, although without fatal results, following 29 per cent of the operations in which anastomoses were made between the biliary tract and the gastrointestinal tract. Hitherto we have had no logical means by which to combat this type of infection.

We have demonstrated in the experimental laboratory that sulfanilamide is excreted in the bile. External biliary fistulae were made in dogs, large doses of sulfanilamide were given to these animals, and we were able to recover sulfanilamide in the bile in amounts equivalent to those present in the blood. Clinically, we have tried sulfanilamide in several cases of cholangitis and results have been promising. In one case an anastomosis between the gall-bladder and the jejunum had been performed, a cholecystoduodenostomy or cholecystogastrostomy being rendered impossible by an extensive carcinoma of the stomach which had invaded the common duct and resulted in jaundice. After operation, as is often the case when the lower portion of the intestinal tract is anastomosed to the biliary system, severe cholangitis with chills, fever, and jaundice developed. The patient was treated with sulfanilamide and within forty-eight hours the chills and fever had subsided and the temperature fell to normal levels. We have since observed similar responses to sulfanilamide in other patients with cholangitis. I therefore believe that sulfanilamide offers a definite promise of being as valuable an antiseptic in the biliary tract as it has proved to be in certain stubborn infections of the urinary tract.

A third troublesome postoperative complication following operations on jaundiced patients has been pneumonia. In many instances the pneumonia begins with a patchy atelectasis. Spinal anesthesia used in operations on the upper abdomen appears to increase the patient's susceptibility to this complication and local anesthesia diminishes the risk to a minimum. Following operation the patient should be instructed in periodic deep breathing exercises, the position should be changed frequently, and the usual wide adhesive support of the dressing should be dispensed with, the dressing being covered by a single longitudinal strip of adhesive which will have no tendency to limit the respiratory movements.

SUMMARY

1. With the advent of vitamin K for the control of the hemorrhagic diathesis in jaundice, with the use of the continuous drip of glucose in the prophylaxis and treatment of postoperative liver failure,

and with the prospect that sulfanilamide may be of value in the control of cholangitis, it is probable that there will be a lowering of the surgical mortality in patients with obstructive jaundice and an increasing interest in the surgical treatment of carcinoma of the head of the pancreas.

2. Twelve cases of radical resection of the head of the pancreas have already been reported; six patients have survived operation, and one of these patients (reported by Whipple) is still alive and well nearly three years after the original operation.

3. The greatest progress in the surgical attack on carcinoma of the pancreas will come when physicians and surgeons recognize that carcinoma of the pancreas is a curable disease provided the diagnosis is established before the tumor has invaded vital structures.

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SARCOMAS OF THE SMALL INTESTINE*

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INTRODUCTION

Of the tumors found in the small intestine, sarcomas are the most frequently reported. Of the 11,000 autopsies performed at the Cook County Hospital from 1929 to May, 1938, 183 were malignant tumors of the intestine, ten of which were found in the small intestine. Seven of these ten cases were carcinomas, one a malignant argentaffinoma, and two lymphosarcomas. Of the surgical and biopsy specimens of the intestine, five cases of the small intestine were encountered four of which were carcinomas and one a leiomyosarcoma.

The above figures include the three cases to be reported in this paper.

The most frequently described sarcoma of the small intestine is the lymphosarcoma, particularly the reticulum cell type. In 1919, Graves[1] reviewed the literature and collected a total of 249 sarcomas of the intestine. In 1932, Ullman and Abeshouse[2] added 126 cases, including one of their own. Since then cases have been reported by Raiford,[3] Magnusson,[4] Geschickter,[5] Mayo and Robbins,[6] Joyce,[7] Leveuf and Godard,[8] and others.

Of the more infrequent types of sarcomas found in the small intestine, leiomyosarcoma, fibrosarcoma, spindle cell sarcoma and giant cell tumors have been reported in the literature by Nickerson and Williams,[9] Goldsmith,[10] Glass and Oldberg,[11] Geschickter,[5] Baltzar,[12] Koch,[13] Gohn and Hintz,[14] Van Knowe,[15] Libman,[16] Magnusson,[4] Renvall,[17] Bjorkenheim,[18] McDermott,[19] and others.

We have the opportunity of reporting in addition to two cases of lymphosarcoma a case of leiomyosarcoma of the small intestine which was removed at operation and submitted for examination to the surgical pathology laboratory.

REPORT OF CASES

Case 1. A white man, 50 years old, was apparently perfectly well until four weeks prior to his entrance into the hospital. At that time he experienced anorexia, his skin turned yellow, he suffered dull, aching pains in the epigastrium, usually one hour after meals. At the time of his admission to the hospital, the pain was radiating in character and was aggravated by the ingestion of fatty and fried foods. On the four days prior to admission, he noticed black stools. Chills and fever were present for ten days, and in the previous four weeks he had lost 20 pounds.

The patient's temperature was 101°F., his pulse 90, respiration 24, and blood pressure 110 systolic and 70 diastolic. He was markedly jaundiced. A few râles were heard in both bases. The abdomen was greatly distended and elicited a distinct fluid wave. The liver was palpated four fingers below the right costal arch, and its edge was irregular and nodular. The spleen was enlarged and firm on palpation.

On the basis of these clinical findings a diagnosis of a primary carcinoma of the pancreas or extrahepatic bile ducts with extensive metastases to the liver was made. Bile was found in the urine. The patient died two days after admission to the hospital, and a detailed laboratory work-up could not be done.

Autopsy showed a well developed white male, 181 cm. long, and 72 kilograms in weight. The skin was yellow green in color and the sclerae were yellow gray. The abdomen was covered diffusely with scratch marks. The abdominal cavity contained 150 c.c. of a blood-tinged fluid. The surface of the liver was covered by loosely adherent blood clots.

The stomach was markedly distended and filled with coffee brown fluid. The mucosa was light brownish gray and the folds were distinct. In the second portion of the duodenum there was a firm cauliflower-like mass measuring 60 by 45 mm. The surface of this mass

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was yellowish-brown-gray, and in the center there was a deep ulcer measuring 30 by 40 mm. covered by a dirty greenish-gray membrane.

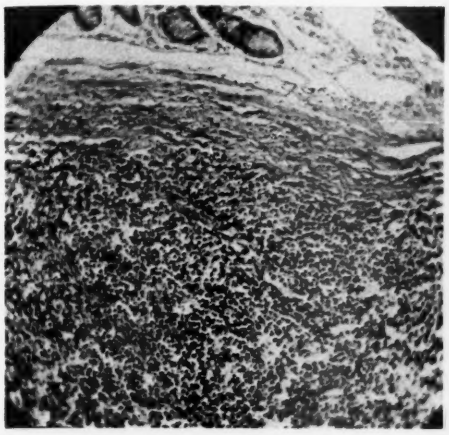

Fig. 1. Case I. × 72. Hemalum and eosin stain. Showing diffuse infiltration of the lymphoid cells into the muscularis propria.

On tracing the common duct from the liver, it was found to empty into the duodenum on the superior margin of the ulcer. The lumen was occluded at its tip, and the ampulla was replaced by the dirty greenish-gray to yellowish-gray tumor tissue. Beyond this obstruction the common duct was dilated to a circumference of 31 mm. The remainder of the mucosa of the small intestine was smooth and grayish-tan in color. The large intestine was smooth except that in the cecum there were four isolated, freely movable sessile nodules, the largest being 15 by 5 mm. in diameter and of a purple-grayish-tan in color.

The liver weighed 4,250 Gm. Its surface was profusely studded with grayish white nodules which had umbilicated centers and measured up to 8 mm. in diameter. The sectioned surface of the liver was grayish-green mottled with circumscribed areas of purple-gray. The markings of the liver lobules were distinct. The bile ducts were very much dilated and contained thick, viscid bile. The gall-bladder was distended and also contained bile of a similar appearance.

The pancreas measured 16 by 50 by 40 mm. The pancreatic duct was dilated to a diameter of 3 mm. and filled with a thick mucoid material. The duct as it approached the duodenum became more and more dilated and emptied alongside the common duct at the superior margin of the ulcerated tumor mass. The mouth of this duct was compressed by this greenish to yellowish gray tissue. Throughout the body of the pancreas were found opaque yellowish gray white nodules. The body of the pancreas,

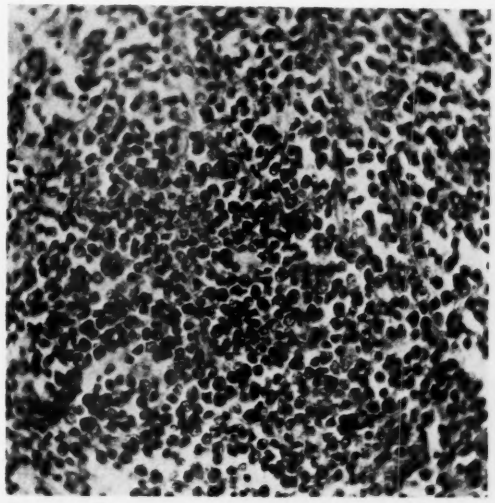

Fig. 2. Case II. × 144. Hemalum and eosin stain. Showing the diffuse infiltration of the tumor cells into the wall of the intestine.

the left adrenal, and the upper pole of the left kidney were firmly bound down to each other by yellowish-gray to purplish-gray tissue.

The periaortic lymph nodes were enlarged up to 40 mm. in diameter and when sectioned were light yellowish-gray to purplish-gray in color.

Microscopic Findings. Histologic studies were made from different levels of the tumor in the duodenum, from the liver, the peripancreatic lymph nodes, the pancreas, the kidneys, and the nodes of the intestine in the region of the cecum. The tissues were stained with hemalum eosin, Bielschowsky's silver stain, Heidenheim iron hematoxylin, and iron carmine stain.

Sections taken through the ulcerated area of the duodenum revealed the surface of the ulcer to be composed of a layer of necrotic tissue in which pink staining residue of cells was seen. These cells were enmeshed in fibrin. At the margin of the ulcer, the duodenal mucosa was well preserved. In this area the submucosa up to the muscularis mucosa was infiltrated by eosinophiles, leucocytes, and plasma cells. Beneath the muscularis mucosa were numerous Brunner glands which were widely separated from each other by large numbers of deeply staining lymphoid cells with round, oval, or slightly indented nuclei, many of them containing distinct nucleoli.

The chromatin granules were coarse and deposited chiefly in the periphery of the nucleus to be connected with each other by fine, broken chromatin threads.

The cytoplasm was acidophilic, usually small in amount, and surrounded by a distinct cell membrane. The cells separated widely and often replaced the fibers of the muscularis propria (Fig. 1) and extended into the fat tissue of the subserosa. Beneath the ulcerated area described above, small areas of necrosis sometimes were seen associated with hemorrhage and focal areas of fibrosis. There were occasional multinucleated cells with nuclei closely resembling those of the lymphoid cell described above. Atypical mitotic figures were frequently found. The blood capillaries and venules were dilated, and in some venules small accumulations of tumor cells were seen.

A section of the ulcer taken through the area where the common duct and pancreatic duct enter into the duodenum showed a diffuse ulceration of their mucous lining with the formation of a necrotic membrane. Beneath this membrane were large groups of lymphoid cells similar to those described above, extending into the wall of the pancreatic and common duct. Silver stains revealed fine fibrils surrounding the individual cells of the tumor.

The microscopic examination of the liver dislosed that in many places the sinusoids were markedly dilated and filled with lymphoid cells of the type described in the duodenum. The liver cords were atrophic. In places large portions of the liver parenchyma were replaced by lymphoid cells between which numerous multinucleated cells were seen. The adjacent liver parenchyma was compressed, and many of the liver cells were stuffed with a brownish-green pigment. Small bile casts were seen in the intercellular bile capillaries. The Kupffer cells were swollen and iron carmine stain showed them to be stuffed with blue staining iron granules. The periportal areas showed a moderate infiltration of round cells, and in places the blood vessels were occluded by tumor thrombi.

The normal architecture of the peripancreatic lymph node was completely destroyed by large numbers of lymphoid cells and many multinucleated cells similar to those described in the tumor mass of the duodenum. The capsule of the lymph node and the adjacent fatty tissue were infiltrated by these tumor cells. Throughout the lymph node the blood vessels were dilated and thin-walled.

In sections of the pancreas the lobules were found to be well preserved, but the perilobular and interlobular connective tissue and fat tissue were diffusely infiltrated by the lymphoid cells and plasma cells. Here and there small islands of fat tissue contained bluish staining calcium material.

Anatomic Diagnosis. Lymphosarcoma (reticulum cell type) of the duodenum, involving the ampulla of Vater, with extension to the tissue about the left adrenal, left kidney, and the pancreas. Metastases to the liver, to the periaortic, and peripancreatic lymph nodes. Also: (1) bronchopneumonia in the right lower pulmonary lobe; (2) syphilitic aortitis and moderate sclerosis of the coronary artery; (3) moderate ascites, icterus gravis, nodose goiter, multiple polyps of the cecum and focal fat necrosis of the pancreas.

Case II. A white man, aged 42, entered the Cook County Hospital on July 7, 1936 with a complaint of abdominal pain for the previous one and one-half years, associated with frequent vomiting. The vomitus was occasionally coffee-ground in color. A weight loss of 30 pounds occurred during the course of his illness.

The patient's skin was slightly icteric. The temperature was 105 degrees, pulse 100, respirations 24, and the blood pressure 108 systolic and 50 diastolic. Small lymph nodes were palpable in the supraclavicular region. The lung examination revealed no abnormal findings. A systolic murmur over the apex of the heart was heard. The liver was enlarged two fingers below the level of the chest. *X*-ray examination of the gastrointestinal tract was negative.

The red blood cell count was 3,370,000 and the white cell count was 7,400 with 84 per cent polymorphonuclear leucocytes. The hemoglobin was 50 per cent on admission. An examination of the gastric juice after an Ewald's meal revealed 64 units of free hydrochloric acid. Fecal examination was repeatedly negative for blood. Electrocardiogram readings were normal. Wassermann tests were negative. Clinically the patient offered a symptom complex which was difficult to interpret. He was placed under observation, and after a time it was considered advisable to explore the abdomen surgically for a possible carcinoma

of the pancreas. At this time there was much tenderness over the entire abdomen, and a questionable mass was palpated in the right upper quadrant.

At operation the small intestine and mesentery were found to be covered with tumor tissue. The involvement was too extensive for resection, and only a biopsy was taken for diagnosis. A section of the biopsy revealed a lymphosarcoma. Postoperatively the patient developed a marked ascites and pitting edema of the lower extremities. Four and one-half weeks after the operation he expired.

Autopsy Findings. The patient was a poorly nourished white man whose skin was dirty gray-brown in color. The superficial lymph nodes were not enlarged. The lower half of the abdomen was slightly distended, and near the midline below the right costal arch was a linear scar 13 cm. in length. There was distinct clubbing of the fingers and toes.

The midline fat was absent. The abdominal cavity contained 1,800 c.c. of an opaque light yellow gray fluid. A loop of small intestine and greater omentum was adherent to the anterior abdominal wall in the region of the scar. The greater omentum contained moderately firm, light pinkish gray plaques measuring up to 4 by 2 by 1 cm. in diameter. Similar though larger plaques were found in the gastrocolic ligaments. In the mesentery of the small intestine, near the root, were several moderately firm, light pinkish gray nodes, the largest 3 by 1 by 2 cm. in diameter. The loops of the small intestine were markedly distended by gas and in places adherent to each other.

Shining through the serosa were many firm, lobulated, grayish nodes, which often involved the entire circumference and extended into the adjacent mesentery. The largest of these nodes measured 11 cm. in longitudinal and 6.5 cm. in transverse diameter.

The mucosa of the stomach was light pinkish-tan. The folds were distinct. Twenty mm. from the pyloric ring, the posterior and lateral wall of the first portion of the duodenum showed an ulcerated oval plaque measuring 5 by 3 cm. in its greatest dimension. The ulcerated area was kidney-shaped and exposed a light grayish-tan and moderately firm tissue. The lower portion of the plaque extended into the second portion of the duodenum. In the third portion of the duodenum the wall was thickened up to 20 mm., was gray-white and moderately firm, and contained an 18 by 10 mm. bean-shaped ulcerated area.

The uppermost portion of the jejunum was twisted upon itself, the wall was infiltrated by numerous moderately firm, pale purplish-tan and centrally ulcerated, discrete, and confluent plaques which involved all layers of the wall, obscuring their differentiation. The largest plaques measured 4 by 3 cm. in diameter and were raised for about 8 mm. These plaques continued throughout the jejunum and in places were fused to form large solid masses which completely surrounded the lumen of the intestine, without constricting it. The circumference of the intestine in that region measured 95 mm. There were multiple irregular ulcers exposing dirty, light yellowish-gray tissue. In the midportion of the ileum the changes became gradually less extensive, but single ulcerated plaques were found down to the region of the ileocecal valve. The mucosa of the large intestine was light purplish-brown. The lumen was filled with thick, pasty brown material. The mucosa of the rectum was light purplish-brown.

The adrenals were flattened by moderately firm, light purple-pink infiltrations of the periadrenal tissue, which was up to 16 mm. thick and was sharply separated from the light yellow-gray of the adrenal cortex. The cortex was about 1 mm. thick. The inner zone was dark brown.

Microscopic Findings. Microscopic studies of this case included the intestine, pancreas, adrenals, spleen, and liver. Azan, hemalum and eosin stain, and silver impregnation were used.

The small intestine in the region of the tumor wall was diffusely infiltrated by large round cells which separated and replaced the preëxistent structures. This infiltration was most extensive in the submucosa and muscularis propria but also affected the subserosa, as a rule. Groups of muscle fibers of the muscularis propria could be encountered between the tumor cells. The infiltration often stopped at the muscularis mucosae, and in these places the mucosa appeared to be well preserved, except for a slight edematous loosening of the stratum proprium. There were, however, areas in which the tumor cells penetrated the muscularis mucosae and spread into the mucosa. They filled and expanded the

villi, while the epithelial lining of the crypts remained intact. Later, the thickened, densely infiltrated villi seemed to fuse together. The

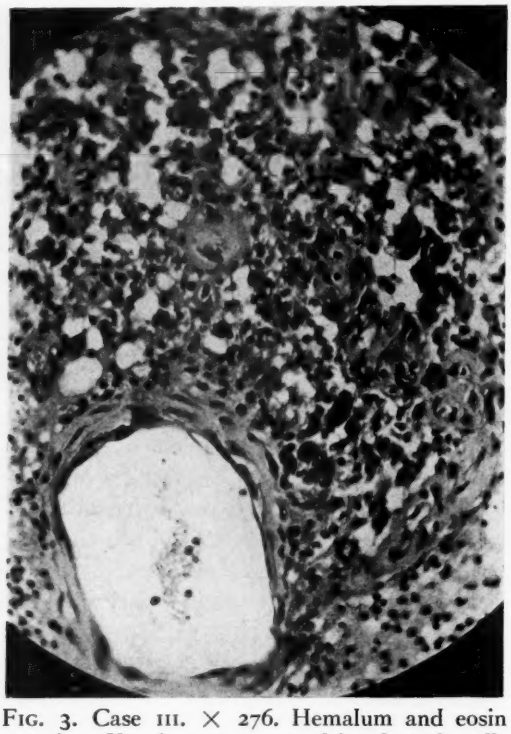

Fig. 3. Case III. × 276. Hemalum and eosin stain. Showing many multinucleated cells and the tendency of the cells to form syncytia. There is a marked infiltration of round cells and polymorphonuclear leucocytes.

crypts disappeared, and the entire thickness of the wall appeared as a solid and uniform mass of tumor tissue bordering at the lumen as well as reaching the serosa. (Fig. 2.)

The tumor cells varied slightly in size and shape. They were round or short oval and were from three to four times the size of small lymphocytes. They showed a distinct rim of homogeneous cytoplasm. Most of the nuclei were round, some oval, and a few bean-shaped. The nuclear membrane was distinct and the chromatin formed coarse granules connected by thinner bridges. There were two or three round nucleoli. Mitoses were very numerous.

In the Azan-stained sections the tumor cells appeared to be arranged in small nests encircled by bright blue fibers of moderate thickness. The blue fibrils often extended between the cells. The coarse fibers carried thin-walled capillaries. The wall of the larger vein was frequently infiltrated by tumor cells which protruded into the lumen in the form of small polyps or undermined the endothelium for a considerable distance.

After silver impregnation the coarser bundles between the cell nests appeared as wavy black strands from which single fine fibrils broke off to extend between the cells. These latter fibrils, too, were distinctly tortuous.

The periadrenal fat tissue was densely infiltrated by tumor cells which resembled those in the intestine. The tumor cells extended close to the capsule of the adrenal cortex but stopped at this point and did not continue into the capsule and cortex. The cortex was well preserved and contained a moderate amount of lipoid material.

The tissue about the pancreas appeared as a uniform mass of tumor cells which often continued into the pancreas following the interlobular septa. The latter thus became much thickened. Here and there the tumor cells also broke into the lobules and replaced the parenchyma, which, under the influence of the invading cells, seemed to melt away. In the remaining portions of the pancreas the acini and islands were intact.

Anatomic Diagnosis. Reticulosarcomatosis of the small intestine extending from the first portion of the duodenum to the ileocecal valve. Sarcomatous infiltrations of the mesenteric, peripancreatic and periadrenal fat tissue. Also: (1) chylous ascites and hydrothorax of the right side; (2) brown atrophy of the liver and myocardium; (3) sand-like uric acid concretions in both renal pelves; (4) focal bronchopneumonia of the right upper pulmonary lobe; (5) atrophy of the thyroid.

Case III. A white woman, aged 38, was admitted to the hospital on May 6, 1937 with complaints of abdominal pain and vomiting for five days. Constipation was present since 1933.

On examination, the patient did not appear acutely ill. Her temperature was 98°F., pulse 118, respirations 20, and the blood pressure 100 systolic and 80 diastolic. Head, neck, and chest examinations were essentially negative. The abdomen was scaphoid. The liver, kidneys, and spleen were not palpable. Tenderness, however, was elicited in the epigastrium and about the umbilicus.

Laboratory examination revealed blood in the stools. The urine examination was essentially negative. The white cell count varied on different occasions from 14,950 to 13,600.

The patient had no bowel movement for two days, and an emesis suggested fecal material. A diagnosis of intestinal obstruction was made, and the patient was transferred to a surgical ward. At operation a tumor in the jejunum was found attached to the mucosa along the mesenteric border. The tumor was obstructing the lumen of the intestine and was associated with an intussusception at the ileojejunal junction. The tumor was excised, and an end-to-end anastomosis was made. Recovery was uneventful.

TABLE I

MALIGNANCIES OF SMALL AND LARGE INTESTINE
1929–1938

		Small Intestine				Large Intestine									
Year	P. M. or Surg.	Duodenum	Jejunum	Ileum	Total	Cecum	Ascending Colon	Hepatic Flexure	Transverse Colon	Splenic Flexure	Descending Colon	Sigmoid	Rectum	Anus	Unclassified	Total
1929	P. M.	A-1 E-1	F-1	.....	3	A-1	.....	.....	.....	A-2 B-1	....	A-4 B-1	A-2 C-1 D-1	.....	..	13
	Surg.	.....	.....	.....	..	.....	.....	.....	.....	.....	....	.....	.....	.....	8	8
1930	P. M.	.....	.....	.....	..	A-1	A-1	C-1	.....	.....	....	A-5 B-1	A-6 B-1	.....	..	16
	Surg.	.....	.....	.....	..	.....	.....	.....	.....	.....	....	.....	A-7 B-1	.....	..	8
1931	P. M.	.....	A-1	.....	1	A-1	.....	A-1	A-1	.....	....	A-2	A-4 B-1	.....	..	10
	Surg.	.....	.....	.....	..	A-1	.....	.....	.....	.....	....	.....	A-21 D-4	.....	..	26
1932	P. M.	.....	.....	.....	..	A-3	A-1 B-1	.....	.....	A-1	A-2	A-2 B-1	A-4	.....	..	15
	Surg.	.....	.....	.....	..	A-6	.....	.....	.....	.....	....	.....	A-34 D-7	.....	..	47
1933	P. M.	A-1	A-2	.....	3	A-2 B-1	.....	A-1 B-2	.....	.....	....	A-4 C-1	A-7 D-2	.....	..	20
	Surg.	.....	A-1	.....	1	A-13	.....	.....	.....	.....	....	.....	A-44 D-1	.....	..	58
1934	P. M.	.....	.....	.....	..	A-2 E-1	A-1	A-1	A-2	A-2	A-4	A-8 B-1 C-1	A-10 B-3 D-1	E-1	..	38
	Surg.	.....	.....	.....	..	.....	.....	A-1 E-1	A-1	.....	A-1	A-3 B-1	A-42 B-3 C-1 D-6	.....	..	60
1935	P. M.	.....	A-1	.....	1	.....	.....	.....	.....	.....	A-3	A-6	A-3 B-1	.....	..	13
	Surg.	.....	A-2	.....	2	A-4	A-1	A-2 B-1	A-1	A-1	....	A-9	A-48	A-1	..	68
1936	P. M.	G-1	.....	G-1	2	A-3	.....	.....	A-2 E-1	A-1	....	B-3	A-8	.....	..	18
	Surg.	.....	.....	.....	..	A-2	.....	A-1	A-1 B-1	A-1	....	A-8	A-58 B-5 C-2	B-1	..	80
1937	P. M.	.....	.....	.....	..	B-1	A-1	E-1	A-1	.....	A-1	A-6 E-2	A-12 B-1	.....	..	26
	Surg.	.....	.....	H-1	1	A-3	.....	A-2	A-1 B-2	A-1	....	A-14	A-65 B-8 C-2	B-1 D-1	..	100
1938	P. M.	.....	.....	.....	..	.....	.....	.....	.....	.....	....	.....	A-4	.....	..	4
	Surg.	.....	.....	A-1	1	.....	.....	.....	.....	.....	....	A-4	A-17 B-1	D-1	..	23
Total		4	8	3	15	45	6	15	14	10	11	87	449	6	8	651

Key: A—Adenocarcinoma
B—Colloid carcinoma
C—Scirrhous carcinoma
D—Squamous cell carcinoma
E—Medullary carcinoma
F—Argentaffinoma
G—Lymphosarcoma of the reticulum cell type
H—Leiomyosarcoma

Surgical Pathology Report. The specimen consisted of a piece of jejunum 2 cm. long. Extending into and completely obstructing the lumen was a firm mass measuring 3 by 2.5 cm.

in diameter. This mass was attached to the mesenteric portion of the mucosa by a broad base measuring 2.5 cm. On sectioning, the tumor was light grayish-yellow, mottled with small purple areas up to 0.5 cm. in diameter.

Microscopic Description. Sections of the tumor were stained with hemalum and eosin after the Van Gieson method, and with Mallory phosphotungstic acid hemotoxylin.

The mucosa overlying the node was missing, and the free surface was composed of a necrotic membrane infiltrated by numerous polymorphonuclear leucocytes. Beneath this membrane the tissue was composed of interlacing bundles of elongated and tortuous cells containing large and oval nuclei with coarse chromatin granules scattered irregularly throughout. Many of the nuclei contained distinct nucleoli. The cytoplasm was acidophilic and surrounded by an indistinct membrane which, in places, seemed to be continuous with the adjacent cellular membrane of another cell. (Fig. 3.) In addition to this type of cell, numerous multinucleated giant cells were seen. Stained after Van Gieson, these cells appeared yellowish-brown, surrounded by fine, pale pink connective tissue fibrils. In sections stained with Mallory's phosphotungstic acid hemotoxylin, the cells contained fine longitudinal fibrils in their cytoplasm. These were also present in some of the multinucleated giant cells. The bundles of cells were widely separated by accumulations of neutrophilic and eosinophilic leucocytes. The blood vessels were markedly dilated and thin-walled.

The diagnosis of a leiomyosarcoma was made.

DISCUSSION

In our study of the autopsy material at the Cook County Hospital from 1929 to 1938 (Table 1), we found 183 malignancies of the large and small intestine. Of these 173 were located in the large bowel and ten in the small bowel. In the larger group, the average age for females was 53.95 years and for males 55.47 years. The youngest female was 28 years, the youngest male 16 years. The oldest female was 80 years, and the oldest male the same. Of the malignancies of the small bowel, the average age for females was 46 years and for males 52 years. The youngest female was 42 years, the youngest male 36 years. The oldest female was 49 years, the oldest male 77 years.

In our series, there were 129 males and fifty-four females. There were 154 white patients and twenty-nine colored.

In our surgical series from 1930 to May, 1938, excluding 12,705 appendectomies, 1,560 operations and biopsies were performed on the large and small bowel. In this series, 483 malignancies were found. Only five were located in the small intestine. Of the 478 malignancies of the large bowel the average age for females was 54.62 years and for males 55.24 years. The youngest female was 30 years, the youngest male 20 years. The oldest female was 81 years, the oldest male 79 years. In the five malignancies of the small bowel, the age and race were not obtainable. The age of twenty females and sixty-seven males in the group of large bowel malignancies was not obtainable; our age average was determined from the remainder of the 396 cases.

Lymphosarcoma for some time was frequently confused with Hodgkin's disease, leucosarcoma, and lymphatic leucemia until Kundrat[20] first differentiated it from the group of closely allied diseases of the lymphatics. He describes the lymphosarcoma as a tumor arising only from a group of lymph nodes and not from a single node. Occasionally it may arise in the lymphoid tissue of the mucous membrane from which it may extend to the neighboring lymph nodes and the surrounding tissue, as is well demonstrated in two of the cases reported here. He segregates these tumors from true neoplasms because they are not spontaneous growths of multiple origin with extension by metastases, but a regional disease of lymphoid tissue which propagates itself through the lymph paths. However, it has since been shown that distant metastases have occurred. (Ewing,[21] Libman,[16] Koch,[13] Graves,[1] Ullman and Abeshouse.[2])

Two examples of distant metastases are demonstrated in the cases of lymphosarcomas described in this paper. In the first case distant metastases were found in the liver and sinusoids of the liver lobule.

In the second case the tumor was found in the periaortic lymph nodes, and it had also invaded the lumen of the blood vessels, as well as the wall of the blood vessels. We feel, therefore, that these tumors should not be segregated from the other types of malignant neoplasms, since the lymphosarcomas possess the same potentialities of dissemination by way of the blood stream to the distant parts of the body. It cannot be denied, however, that the greatest growth is local, with marked invasion of the adjacent organs.

The recognition of a lymphosarcoma from a histologic examination of the tumor tissue may lead to a good deal of confusion when one considers the possibility of an existent Hodgkin's disease, leucemia, or intestinal tuberculosis. It is further confusing since the true tumor may possess a single type or all varients of tumor cell found in a true case of lymphosarcoma. Lubarsch and Henke[22] describe eight different cell types: the lymphocytic type; the lymphoblastic type; the reticulum cell type, composed of fine cytoplasmic processes, forming a network in which are found other cellular elements such as lymphocytes and lymphoblasts, although at times the network is so dense that there is no room for other cells and the tissue resembles protoplasmic glia; the dwarf cell type; the giant cell type; cells of phagocytic structure, composed of honeycombed cytoplasmic structure in which products of ingestion are frequently seen; the plasma cell type; and the plasmomast cell type.

The two cases reported here are of the reticulum cell type which is comparable with the lymphoblast type described above.

That these tumors occur only in one portion of the intestine or diffusely throughout the small intestine and at times involve the large intestine has been frequently shown. A case of each type is represented here. The focal types are more malignant than the diffuse type,[21] although both types may prove rapidly fatal.

The third case in this report deals with a leiomyosarcoma. Histologic examination, especially with Mallory phosphotungstic acid hemotoxylin, discloses the longitudinal myofibrils in the bundles of tumor muscle cells, and even in some of the multinucleated giant cells. The origin of this type of tumor may be from either the muscularis mucosa or the muscularis propria. This tumor is infrequently found in the small intestine. The ratio of myosarcomas to other types of tumors in the small intestine is 2 to 63, according to Corner and Fairbanks,[23] 1 to 96, according to Speese.[24]

The pathogenetic basis of tumors of the intestinal tract is far from being definite, although many suggestions have been made regarding their origin. Lymphosarcomas of the intestine have been regarded by some authors to be due to infection, particularly tuberculosis, syphilis, or typhoid fever (Joyce,[7] Ligman,[16] Nothnagel,[25] Birch-Hirshfield,[26] and others). Ribbert[27] believes that these tumors are produced by aberrant, undifferentiated cells in which tuberculosis is purely accidental. In our cases no evidence of a latent or active tuberculosis was found at post-mortem examination. The clinical symptoms also were more in keeping with a diagnosis of malignancy rather than one of tuberculosis.

It is interesting to note in both cases of lymphosarcoma reported here that there was a pronounced absence of symptoms referable to intestinal obstruction. This is readily explained by the nature of the tumor growth—it grows peripherally and excavates the lumen of the intestine by ulceration, sometimes causing aneurysmal dilatation of the intestine. This finding is in keeping with those of other authors, although Liu[29] and Miller[30] have shown that obstruction is more common either by constriction of the lumen or by intussusception. Sarcomas are more frequent in the small intestine than are carcinomas, according to reports in the literature.[1,3] In our series, however, sarcoma was found to constitute only 20 per cent of all tumors of the small bowel. Nickerson and Williams[9] similarly report two sarcomas in ten cases of small intestinal tumors.

The other types of sarcomas found in the small intestine, chiefly the myogenic and

fibrosarcomas, usually offer early symptoms of intestinal obstruction since they have a tendecy to become pedunculated.

Of all the malignancies of the small intestine, the lymphosarcomas are the most rapidly growing, spreading early to the adjacent lymph nodes and later in the course of the disease to distant organs. Attempts at operative removal usually prove unsuccessful, since local tumor growths have recurrences and diffuse tumors are more or less inoperable. Liu,[29] however, has reported a number of cases in which patients have lived four years after resection of the tumor.

X-ray therapy should be given cautiously since the marked sensitivity of the mucosa to the *x*-rays may cause a secondary ulcerative and suppurative enteritis.

The myogenic tumors, due to their tendency to metastasize late, offer a good prognosis at early removal, although recurrences have been noted.

SUMMARY

Three cases of sarcoma of the small intestine are reported, two lymphosarcomas and one leiomyosarcoma, the former growing rapidly and spreading early to the adjacent lymph nodes, and the latter growing and metastasizing late. The lymphosarcomas are at times difficult to diagnose and may be confused with lymphatic leucemia, leucosarcomas, or Hodgkin's disease. In our series of cases, the number of sarcomas of the small intestine is much lower than the number of carcinomas.*

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* Since the submission of this manuscript, we have observed four additional malignancies of the small intestine in the surgical pathology laboratory of the Cook County Hospital. One was an annular constricting adenocarcinoma of the ileum; two were stenosing lymphosarcomas, one in the ileum and the other in the jejunum; the fourth appeared clinically to be a ruptured viscus, but proved to be a perforated ulcerating lymphosarcoma of the ileum. All of these were in males from 50 to 56 years old.

IMMEDIATE SURGICAL VERSUS EXPECTANT MEDICAL TREATMENT OF CLINICALLY ACUTE GALL-BLADDER DISEASE*

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THE treatment of acute inflammation of the gall-bladder is a much debated problem in medicine today. Until recently, the expectant treatment was the routine procedure and only when the findings indicated a very severe suppurative process or when symptoms persisted after medical therapy, was drainage of the gall-bladder instituted. Cholecystectomy, however, was not considered safe treatment for acute gall-bladder disease. The expectant medical approach was justified on the theory that an acutely inflamed gall-bladder (in contradistinction to an acutely inflamed appendix) seldom perforated and that the danger to life from such a complication was not very great. Cholecystectomy was condemned as an operation which, at the acute stage, was considered more dangerous than cholecystostomy.

This conservatism is reflected in the report of Branch and Zollinger[2] who insist that only when cholecystitis is complicated by peritonitis should the patient be subjected to a surgical operation. To substantiate this they review 235 cases of acute cholecystitis only thirty-four of which were treated by immediate operation with a mortality of 20.5 per cent. On the other hand, among 195 patients whose operations were delayed, the mortality was only 8.7 per cent. Lahey[13] states that he has never seen an acute perforation of an inflamed gall-bladder which was not walled off. Federov[5] feels that surgical intervention during the acute stage involves much greater danger than in the chronic stage. Behrend[1] finds the mortality very high following operation in acute gall-bladder disease. Hartel[8] definitely prefers the conservative treatment.

On the other hand, Pfeiffer,[15] Robinson,[16] and Judd and Phillips[11] feel that during the acute stage operative intervention is definitely indicated. Among the more recently published articles, many point out that acute gall-bladder inflammation often leads to complications which seriously endanger the life of the patient. Wolfson and Rothenberg[21] reported thirty-one cases of acute non-calculous cholecystitis in six of which perforation occurred. In a large group observed and operated on by Heuer,[9,10] the incidence of gangrene or perforation was between 20 and 23 per cent. Taylor[20] thinks that much depends on the interval between the onset of the acute attack and the time of operation. Among 102 patients with acute gall-bladder disease, he found a mortality of 5 per cent in those subjected to operation within four days of the onset of the attack, while the death rate was 23.8 per cent where operation occurred later than the fourth day. Gray[6] cites the experience of some observers that results were much poorer when operation took place more than two weeks after the onset of the attack.

If the surgeon decides to operate during the acute stage, he has the choice of two procedures: cholecystectomy and cholecystostomy. A report of 200 operations performed by Steinke[17] in the acute stage shows fifteen deaths among 159 cholecystectomies, a mortality of 9.4 per cent. Of forty-one patients treated by cholecystos-

* From the surgical service of Dr. M. Danzis, at the Newark Beth Israel Hospital and from the Graduate School of Medicine of the University of Pennsylvania. Thesis submitted to the Faculty of the Graduate School of Medicine of the University of Pennsylvania, in partial fulfilment of the requirements for the degree of Master of Medical Science M.Sc. (Med.), for graduate work in surgery.

tomy, eight died—a death rate of 19.5 per cent. This suggests that cholecystectomy is a safer procedure during the acute phase of the illness. Many other authorities are in accord with this. Coughlin,[3] Heuer,[9] Lipschutz,[14] Judd and Phillips,[12] and Stone and Owings,[18] all prefer cholecystectomy for acute gall-bladder inflammation.

To secure further information on this question, we analyzed the data of the Newark (New Jersey) Beth Israel Hospital for the years 1933 to 1936. All charts filed under a diagnosis indicating an acute inflammatory condition of the biliary passages were surveyed. There were 101 cases of this nature. Table I summarizes the cases with reference to diagnosis and treatment. Table II lists only cases which, on operation, were shown to be acute inflammation of the biliary passages. This table excludes medically treated cases as well as those which were found to be non-acute. In this way, it was easier to evaluate results of surgical treatment in unquestionably acute cases. Table III represents a follow-up of thirty-seven cases that were either medically treated, or treated surgically without removal of the gall-bladder.

The charts show that the clinical symptoms (e.g., appearance of patient, tenderness in right upper quadrant, palpable gall-bladder, abdominal rigidity, fever, and leucocytosis) do not necessarily indicate the severity, acuteness or extent of the disease as it was found at operation. One could never tell how extensive or intense the inflammation was until the abdomen had been surgically explored. Acute cholecystitis may mislead, just as does acute appendicitis when, with seemingly minor symptoms, a perforation occurs. Some severe cases of cholecystitis, pericholecystitis, or perforation of the gall-bladder (with or without adhesions) showed such trivial symptoms that the physician believed medical treatment to be justified if not desirable. The data in the literature stress this hazard. Touroff[19] and notably Heuer[10] have emphasized the treachery of acute cholecystitis. When a

TABLE I

Type of Cases	Number	Notes
Operated, acute cholecystitis, ruptured gall-bladder, or empyema of gall-bladder. Cholecystostomy. Died.	10	One not proved to be acute.
Operated, acute cholecystitis or ruptured gall-bladder, or empyema of gall-bladder. Cholecystostomy. Lived.	17	Four not proved to be acute.
Operated, acute cholecystitis, ruptured gall-bladder, or empyema of gall bladder. Cholecystectomy. Died.	4	One not proved to be acute.
Operated, acute cholecystitis, ruptured gall-bladder, or empyema of gall-bladder. Cholecystectomy. Lived.	39	13 not proved to be acute.
Medical treatment only. Acute cholecystitis or empyema of gall-bladder. Died.	2	
Medical treatment only. Acute cholecystitis or empyema of gall-bladder. Lived.	21	2 refused operation. 2 left hospital against advice. 1 rehospitalized for cholecystostomy.
Medical treatment only. Acute hepatitis and cholecystitis. Lived.	1	
Partial cholecystectomy. Lived.	2	
Medical treatment only. Hepatic calculi, cholangitis. Lived.	1	
Medical treatment only. Cholangiitis. Lived.	1	
Operated. Empyema of gall-bladder and carcinoma. Incision and drainage of gall-bladder abscess. Died.	1	
Exploratory freeing of adhesions. Lived.	1	
Incision and drainage of pancreas. Died.	1	
Total	101	
No history of previous gastrointestinal complaints.	12	
Previous gastrointestinal history. Attack.	55	
Previous gastrointestinal history, other than an attack.	15	
Surgical or pathologic findings proving the acute condition.	53	

Table II

Cases of Surgically Verified Acute Inflammation	No. of Cases	Notes
Acute cholecystitis or empyema. Cholecystostomy. Died.	5	1 had bronchopneumonia. 1 had severe cardiac disease.
Acute cholecystitis or empyema. Cholecystostomy. Lived.	13	1 had pancreatitis and fat necrosis. 2 had pericholecystitis.
Acute cholecystitis or empyema. Cholecystectomy. Died.	1	Had also pericholecystitis.
Acute cholecystitis or empyema. Cholecystectomy. Lived.	22	1 had a partial cholecystectomy done. 2 had pericholecystitis. 1 was chronic cholecystitis with old and new adhesions.
Ruptured gall-bladder. Cholecystectomy. Died.	1	
Empyema of gall-bladder with biliary sinus and pericholecystitis. Cholecystectomy. Lived.	1	
Acute cholecystitis, covered perforation, pericholecystitis. Cholecystectomy. Lived.	2	1 patient also had diabetes and pyelitis.
Chronic cholecystitis with necrosis and hemorrhage, pericholecystitis, adherent small intestinal loops. Cholecystectomy, enteroenterostomy, repair ventral hernia. Died.	1	
Subacute appendicitis, acute pancreatitis, acute cholecystitis, appendectomy, cholecystostomy. Died.	1	
Acute cholecystitis, cholelithiasis, choledochelithiasis, cholecystostomy, choledochostomy. Died.	1	
Empyema of gall-bladder, subacute hepatitis, pericholecystitis involving stomach, duodenum, and hepatic flexure, cholecystostomy. Died.	1	
Chronic cholecystitis, suppurative pericholecystitis, cholecystectomy. Lived.	1	
Empyema of gall-bladder, chronic appendicitis fibroid uterus, cholecystostomy, appendectomy, hysterectomy. Lived.	1	
Acute pancreatitis, acute hemorrhagic cholecystitis, cholecystectomy. Died.	1	
Acute cholecystitis in the presence of adenocarcinoma. Partial cholecystectomy. Lived.	1	
Total.....	53	

severely ill patient reaches the stage at which operation becomes imperative, he is usually a very poor surgical risk. Consequently, under these circumstances, the temptation is to perform cholecystostomy with or without drainage of a contiguous abscess. In such cases, the mortality is very high. (Table II.) It is reasonable to assume that the death rate would have been lower if expectant treatment had been abandoned at an earlier stage when the patients could have been operated upon with less risk. The patients would have been in better condition, the surgical procedure would have been simpler because the anatomic configurations would not have been so distorted.

If a patient with extensive inflammatory and structural changes in the biliary passages survives an operation, he still faces the possibility of a recurrence of symptoms and the necessity for a secondary operation. These points speak in favor of early operation.

Theoretically, early operation for acute cholecystitis is as desirable as it is for acute

appendicitis. But there is a practical difficulty: Many surgeons are capable of removing an acutely inflamed appendix; fewer are competent to remove an acutely inflamed gall-bladder. Clinically, it would seem that early operation would diminish the mortality from acute cholecystitis; but due to the lack of experience among many surgeons, the procedure may actually promote a higher death rate.

TABLE III
FOLLOW-UP DISTRIBUTION OF THE MEDICALLY TREATED CASES AND CASES SUBJECTED TO CHOLECYSTOSTOMY

Subsequent Course	Cholecystostomies	Medically Treated	Total
Discharged from hospital...	17	20	37
Feeling well.....	7	6	13
Having complaints or objective signs.....	5	4	9
Had cholecystectomy done later.....	2	2	4
Not traced.....	3	6	9
Having complaints but operation otherwise contraindicated.....	0	2	2

Reviewing the medically treated cases, we find twenty-three diagnosed as acute cholecystitis or empyema of the gall-bladder. (Three more medically treated cases in this series have no significance for this analysis; the diagnoses were: (1) acute inflammation of the liver and gall-bladder; (2) hepatic calculi and cholangitis; and (3) cholangiitis. In the first case there was serious doubt as to the existence of any real gall-bladder disease.) Of these twenty-three patients, two died; two refused operative consent; two left the hospital against the doctor's advice; and one was discharged unimproved only to be readmitted a few weeks later for cholecystostomy. In the remaining sixteen cases, the attending physician did not intend to apply any surgical treatment. One of these patients had a large palpable mass in the right upper quadrant with fever, rigidity and intense pain. The attending and the consulting physicians agreed that the process was extensive but walled off, and that more could be gained by allowing the acute attack to subside than by prompt surgical interference. None of the remaining fifteen patients persistently exhibited symptoms suggestive of a very acute or serious condition. The mortality in this group was 8.7 per cent.

Fifty-three patients were operated upon and the verified diagnoses were acute cholecystitis and empyema of the gall-bladder. Some had been scheduled for medical treatment and were sent to operation only because the non-surgical therapy had failed. In such cases, the surgical mortality should really have been charged against medical treatment. In twelve of these fifty-three cases, serious complications (such as ruptured gall-bladder and other pathologic findings in addition to the cholecystitis) were found. Among the twelve were eight cholecystectomies with four deaths (50 per cent) and four cholecystostomies with three deaths (75 per cent). The number is small and the cases are not entirely comparable, but the fact remains that the cholecystectomies presented a better picture than the cholecystostomies. This is probably due to the tendency to submit the more serious cases to cholecystostomy.

The results in the remaining forty-one cases can be summarized in a phrase: twenty-three cholecystectomies with one death, and eighteen cholecystostomies with five deaths. The mortality is thus lower among cholecystectomies. The death rate is better than that reported from a study of a large number of chronic gall-bladder cases collected from the statistics of a mixed group of surgeons. In the latter review, the rate ranged from 4 to 9 per cent. Of course, our group is too small to be compared to this large series but it is extensive enough to refute the common statement that cholecystectomy in acute gall-bladder disease carries a very high mortality.

The immediate mortality, however, is not the only question. It is also important to know the ultimate condition of the

patients. The menace of persistent gall-bladder infection has often been stressed. Thus, it has been said that heart disorders may be caused or diabetes aggravated by latent gall-bladder disease; and that cholecystitis may set up a focus of infection. A discussion of this is beyond the scope of this paper. But we tried to determine whether cases treated medically or by surgical drainage subsequently developed complaints referable to the gall-bladder; and we also sought to discover the proportion of these patients requiring secondary cholecystectomy. Data on these points were secured from family doctors, from the operating surgeons and from personal interviews with the patients. The twenty-one medically treated cases and the seventeen instances of cholecystostomy represented thirty-seven patients, because one, first medically treated, reappears in the cholecystostomy group. Thirteen (seven cholecystostomies and six medically treated cases) felt well at the time of the follow-up investigation, from six months to four years after discharge from the hospital. Nine (five cholecystostomies and four medically treated) had definite complaints or objective symptoms (such as biliary fistula), while four patients (two in each group) had been rehospitalized for cholecystectomy. Two others (both medically treated) had definite complaints, but in these cases surgical treatment was contraindicated for other reasons. Nine (five cholecystostomies and four medically treated) could not be traced.

Roughly, half of the located patients who had not received primary cholecystectomy felt well. This might, perhaps, be construed, as evidence against cholecystectomy. The duration of the follow-up interval, however, was not very long and sooner or later some of these patients will probably develop gall-bladder symptoms again. A follow-up analysis of eighty-six cholecystostomies performed by Danzis[4] reveals that twenty-eight were subsequently subjected to secondary operations. He was obliged to do cholecystectomy from fourteen to twenty-two years after cholecystostomy in these cases. The incidence of reoperation was about 30 per cent.

SUMMARY

An analysis has been made of 101 cases, diagnosed as some kind of acute inflammation of the biliary passages. Of these, twenty-three were treated only medically and the diagnosis, though not verified, was probably empyema of the gall-bladder or acute cholecystitis. There were fifty-three surgically verified instances of acute cholecystitis or empyema of the gall-bladder. Twelve of these patients also had a serious complication. Mortality was greatest among the surgically treated complicated cases. Cholecystostomies showed a higher death rate than cholecystectomies, however, in these cases. The next lower death rate is shown by the uncomplicated cases treated by cholecystostomy, followed by the medically treated cases, while the lowest mortality was found among uncomplicated cases subjected to cholecystectomy.

CONCLUSIONS

Cholecystectomy in the hands of a competent surgeon is a desirable form of treatment for uncomplicated cases of acute gall-bladder disease. Its results compare favorably with cholecystostomy and with medical treatment.

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Sutures should be removed as soon as organic union has taken place. The longer they remain in the tissues after having served their purpose, the more likelihood there will be of a conspicuous scar.
From—"The Surgery of Injury and Plastic Repair" by Samuel Fomon (Williams & Wilkins).

AMMONIUM BICARBONATE SECRETED BY SURGICAL MAGGOTS STIMULATES HEALING IN PURULENT WOUNDS*

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UNUSUAL healing effects were obtained by Baer[1] some years ago when he placed living blowfly maggots directly into chronic non-healing wounds. His announcement of the success of this novel treatment attracted a good deal of interest, and during the next few years scores of articles appeared in the medical literature describing the remarkable results of maggot therapy.

The question then arose as to how blowfly maggots can promote healing. Baer apparently was the first to state his belief that these results are not due entirely to the scavenger action of the maggots in cleansing the wound. He conceived the idea that in addition "some biochemical exchange takes place between the maggot and the tissues of the patient." Later, in the Bureau of Entomology and Plant Quarantine, it was found that allantoin,[4,7] a metabolic product present in the maggot secretions, stimulates healing effects similar to those produced by the maggots. Further research in the Bureau showed that urea[5,6,7] also possesses this same characteristic.

Although this therapeutic property of allantoin and urea has since been confirmed and extensive use made of the two products by the medical profession, the possibility still remained that they are not the chief healing agents secreted by maggots. For one thing, they are produced only in minute quantities; and again, they are both regarded as inert substances physiologically.

One soon becomes aware of a metabolic product in maggot excretions which is both abundant and reactive. It is ammonia, and in the combined form in which it occurs in the excretions it is first ammonium carbonate, which is unstable, and then ammonium bicarbonate. In solution the latter has an alkalinity of *p*H 7.7, corresponding roughly with that of maggot excretions. Wounds in which maggots were used also tended to have this same alkalinity.

Uncombined ammonia is of course harmful to the tissues except in the minute amounts formed during metabolism; and any that is produced physiologically is believed to be removed by the liver. Maggots secrete comparatively large quantities of ammonium bicarbonate, along with other residue, directly into the wound, and this occurs without evidence of injury. Accordingly, some preliminary tests were made with this material to determine what effect the pure solution would have when applied to a wound.

The opportunity occurred in 1937 to treat a number of dogs and rabbits that had persistent discharging sores, chiefly on the back and legs. Two per cent solutions of ammonium carbonate and of bicarbonate in sterile water were made up and applied to the wounds in a series of comparative tests. As the use of gauze packs in these cases was out of the question, the wounds were thoroughly moistened several times daily with either of these solutions. The animals showed no discomfort and within two to three days the cleansing and healing effects formerly noted with allantoin and urea began to appear. No differences could be noted between the carbonate and the bicarbonate tests. The wounds, which had

* Contribution from the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture.

remained open and running before treatment, healed with the formation of very little scar tissue and in some cases with a return of hair to the surface. The writer tried the bicarbonate later in the treatment of some minor injuries in his own case and also in some of his associates. When first applied it produced a slight stinging sensation which soon disappeared. In subsequent applications this smarting became less noticeable, and healing appeared to be normal.

The following year a number of physicians and surgeons* became interested in the therapeutic possibilities of these two ammonium compounds. The Bureau supplied concentrated sterile solutions and our coöperators diluted and used them in a few selected cases of discharging wounds of various types. The solutions were applied as 1 or 2 per cent concentrations on gauze packs saturated with the material and in some cases they were irrigated into the wounds.

The fact became evident as the treatments progressed that these two ammonium compounds are each able to promote healing in purulent and indolent wounds. Also no unfavorable effects were observed beyond the preliminary smarting in some cases. With this as a basis, treatments were then applied to a larger number of cases, including such purulent conditions as chronic osteomyelitis, diabetic and varicose ulcers, slow-healing abdominal wounds, abscesses, otitis media and infected lacerations. Ammonium bicarbonate, being more stable and less alkaline, was used throughout these later tests.

An improvement in the condition of the wound similar to that produced by maggots usually began to take place after a few days' application of the treatment. The offensive odor decreased rapidly and the wounds became cleaner. Small areas of fresh granulations could be seen in the wounds and later a general development of this tissue usually occurred.

Following are some case histories supplied by our medical coöperators. They indicate the variety of purulent conditions which were treated, and the results appear to be typical of those usually obtained with this treatment.

Case I. M. K., female, aged 16 years, had a chronic offensive discharge from the left ear. She had had two previous mastoidectomies and the ear had been treated with antiseptic powder insufflated frequently. On examination there was a slight discharge, stringy, clear and very offensive. Two per cent solution of ammonium bicarbonate was instilled into the ear and the patient complained of a stinging sensation. The solution was then diluted to 1 per cent and the ear cleansed daily for two weeks at this strength without discomfort. The concentration was increased thereafter until the patient was able to withstand a 4 per cent solution. After a period of eight weeks the discharge and odor disappeared, and after active treatment had been discontinued for six weeks no discharge or odor has been detected.

Case II. C. H. K., female, aged 13 years, had had a swollen lower lip for six months. At the time of treatment the lip was considerably swollen and covered with crusts. Ammonium bicarbonate, 2 per cent strength, was applied to the lip on cotton packs for half an hour three times daily. In two days the swelling began to subside, the crusts had disappeared, and healing was well under way. Within ten days the lip was back to normal and healing was complete.

Case III. S. W., male, colored, aged about 43 years, had chronic osteomyelitis of the left tibia. Multiple dirty sinuses developed, with malodorous drainage. Dressings with packs

*The writer acknowledges with deep appreciation the medical assistance and the clinical facilities provided by the following coöperators. Without such aid the present investigation would have been impossible.

Dr. Leon M. Bogart, Flint, Mich.; Dr. W. M. Cashman, Warren, Pa.; Dr. Carson K. Gabriel, Quincy, Ill.; Dr. C. C. Joyner, Farmville, N. C.; Dr. Gerald C. Kohl, Sumner, Wash.; Dr. J. J. Kvatsak, Bellevue, Pa.; Dr. M. D. Lederman, New York, N. Y.; Dr. Daniel H. Levinthal, Chicago, Ill.; Dr. Robert B. Lewy, Chicago, Ill.; Dr. Norman G. Mathieson, Ben Avon, Pa.; Dr. E. P. Monahan, Kansas City, Mo.; Dr. H. D. Murdock, Tulsa, Okla.; Lt. Col. N. A. Myll, Vancouver Barracks, Wash.; Dr. J. B. Quicksall, St. Petersburg, Fla.; Dr. G. O. Segrest, Mobile, Ala.; Dr. W. P. Sherlock, Hines, Ill.; Dr. Isidor S. Tunick, New York, N. Y.

saturated with 1 per cent ammonium bicarbonate were applied and kept constantly moist. These were changed daily. In ten days the odor disappeared and the discharge was markedly diminished. As treatments were continued the sinuses became smaller and healthy granulations appeared. The leg "felt better to the patient." In two months the wounds were all healed. *X*-ray films showed no appearance of osteomyelitis.

Case IV. F. K., male, aged 40, had an old compound fracture of the right tibia with malunion and purulent anterior ulcer. This had been the condition for months. Three weeks' treatment with ammonium bicarbonate dressings reduced the ulcer by about 20 per cent and stopped drainage. The general appearance of the wound became healthier, and in five weeks healing was complete.

Case V. W. D., female, aged 51 years, had a large chronic varicose ulcer on the lower left leg, of eighteen years' duration. On examination the ulcer was oozing a clear serum which produced a red rash on the surrounding skin. The entire lower limb was first cleansed with tincture of green soap and sterile water. Then applications of 2 per cent ammonium bicarbonate solution on saturated gauze packs were begun and changed daily. In about one week the ulcer cleaned up and developed a healthy base with good epithelial reaction around the margins. After six weeks' treatment the entire ulcer was healed and the patient was discharged and advised to have proper elastic stockings fitted.

Case VI. A. R., a boy of 15, a chronic diabetic, received a deep laceration of Achilles' tendon. The wound was dressed and tetanus antitoxin was given. The patient went on a vacation but returned in ten days with a severely inflamed leg and a foul discharge from the wound. Temperature was 103 degrees. The wound was washed at once with 2 per cent solution of ammonium bicarbonate, and wet dressings with this material were begun. Both odor and pain decreased markedly and the wound dried up and was completely healed in seven days.

Case VII. S. O. R., male, aged 36 years had severe lacerations of the right thumb and index finger, previously treated elsewhere with apparent healing. At the time of examination the wounds had broken down with excessive purulent discharge and considerable pain. Frequent applications of ammonium bicarbonate, 1 per cent solution, on cotton packs reduced suppuration and pain in two days, and in ten days the fingers were healed. Three months later they had remained healed.

Case VIII. F. E. R., male, aged 52, had a "stitch abscess" following appendectomy and gall-bladder exploration. The patient was obese with low resistance of tissues. The wound was very slow in healing, twice breaking down with considerable drainage and odor, covering a period of five weeks. Finally frequent irrigations and daily wet pads of 1 per cent ammonium bicarbonate brought about cessation of discharge and appearance of firm granulations within ten days. In three weeks the incision was completely healed and has remained so for three months.

Case IX. P. T. O., male, colored, aged 45 years, had had the eye ball removed following an injury to the right eye, but some time later the eye socket became infected. At the time of examination the socket had failed to heal and had discharged for fourteen months. The socket was then cleansed and packed daily with gauze saturated with 1 per cent ammonium bicarbonate. On complaint of pain, the concentration was reduced to one-half, when stinging ceased. In four days the odor and discharge were much reduced and two weeks later the socket was dry and healed.

Case X. M. W., female, aged 64, had a chronic ulcer of the lower left leg due to arteriosclerosis. For one month the ulcer was treated with such drugs as thioglycerol, Ochsner's solution, methylene blue, and potassium permanganate without improvement. There was pain and high temperature, and a purulent fetid discharge was present. At that time treatment with a 1 per cent solution of ammonium bicarbonate on cotton packs was instituted. These packs were kept wet and renewed daily. In a few days the drainage began to subside and the edges of the ulcer cleared up somewhat. Small areas of pinkish granulation tissue started to grow in the center, and two months later the ulcer healed over and the patient was discharged.

Case XI. P. B. T., male, aged 21 years, cut his right index finger on November 28, 1939 but had no medical attention given to it. One week later he had marked lymphangitis and cellulitis of the right arm with a temperature of 106 degrees. An incision over the original

injury released about 4 ounces of pus. The temperature returned to normal, but four days later it rose to 104 degrees with a huge cellulitis of right chest wall. An incision released clear serum. Ten days later another incision was made. Two weeks later the patient had a chill and a temperature elevation to 106 degrees. This was followed by a large empyema of the right side. Repeated incisions were made for three weeks and cultures continued to show streptococcus infection. A rib resection was then performed. Drainage and daily irrigations with Dakin's solution were given for four weeks with no improvement; then irrigations with neoprontosil, then with peroxide, then hexylresorcinol were used without any change. During this period from December, 1938 to April, 1939, sulfanilamide had been administered with no appreciable change noted. At this stage a 2 per cent ammonium bicarbonate solution was used to irrigate the chest cavity three times daily. On the second day of this treatment the pain in the lower chest disappeared and in four weeks the patient was out of bed with no signs of his ailment. He made an uneventful recovery and returned to his work.

Case xii. S. J. S., female, aged 72 years, had one or more varicose ulcers for twenty years. Upon her admittance to the hospital the ulcers had a fetid odor and were badly necrosing. Also the leg was very swollen. The ulcers were thoroughly washed with 1 per cent ammonium bicarbonate, and gauze packs saturated with this material were applied and changed daily. Within two days the odor had disappeared and the necrosed areas were much cleaner. In two weeks the wounds became exceedingly clean and full of fresh granulations and blood vessels. At this time the bases of the ulcers were covered with autogenous pinch grafts, forty-seven in all. Two weeks later, by actual count, forty of these grafts were found to have grown beautifully and the ulcers were practically cured. Usually not more than 50 per cent of pinch grafts take and they have to be repeated from one to six times. The age of the patient and the fact that she had had the ulcers for twenty years must be considered.

Ammonium bicarbonate is readily available commercially and is made on a large scale for various purposes. It also has the advantages of being cheap and easily prepared for use. One-pound bottles can be purchased for about forty cents. At that price a liter of 1 per cent solution costs one cent. A stock solution is made by adding 10 Gm. of the bicarbonate to each liter of cold water and stirring occasionally until dissolved. It goes into solution rapidly. If the containers are tightly corked, both the crystals and the solution will keep well.

A fairly wide range in the strength of the solution has been used with success. This has varied from ½ of 1 per cent to as high as 4 per cent concentration. A growing tolerance to the bicarbonate with repeated applications has been reported in several instances. In some cases the first few treatment have been made with ½ of 1 per cent concentration and then raised to about 2 per cent without discomfort and with especially favorable results in promoting healing. In some reports it is especially stated that the patients were free from discomfort during treatment. Surfaces around the wound not needing treatment are sometimes given a light application of vaseline.

Wounds tended to become alkaline when they were implanted with maggots, and it was believed that such wounds healed more rapidly than those inclined to be acid. Messer and McClellan,[3] in their early study of the hydrogen ion concentration of wounds treated with maggots, also noted: "In all cases the fluctuations in *p*H corresponded with the clinical condition of the wound; the progress of healing being accompanied by a consistent increase in alkalinity while failure to progress toward healing . . . was followed by a marked fluctuation toward acidity." The application of ammonium bicarbonate brings about an alkalinity in the wound similar to that produced by maggots.

A catalyst with a background of unusual chemical interest, namely, the enzyme urease, is apparently the agent responsible for the production of ammonium bicarbonate in maggot secretions. This enzyme, which has been known since 1860, was recently found by Robinson and Baker[8] to occur abundantly in the tissues and excre-

tions of surgical maggots. Urease is specific for the metabolic waste product urea, and it cannot react upon even closely related substances. It is a heavy protein molecule with a molecular weight of 483,000, according to Sumner et al.,[9] while urea is of small size with a molecular weight of 60. Urease hydrolyzes urea and produces ammonium carbonate by means of two successive reactions (Van Slyke and Cullen[10]). A molecule of urease first combines with one of urea. Then it immediately disrupts the urea molecule. From this reaction the enzyme emerges free, and if another molecule of urea is available urease at once reacts upon it without any measurable loss of time. The carbonate, as stated earlier, is unstable and with a loss of one molecule of ammonia it becomes ammonium bicarbonate. Brown[2] found the bicarbonate in maggot excretions but his technique did not show the presence of the enzyme urease.

Urease, urea, and the resulting ammonium compounds comprise a system in living tissues which appears to be of especial interest and significance. A consideration of that system, as it bears upon the growth of tissue in healing wounds, has been part of the investigation here reported, and it will be discussed in a forthcoming article in this Journal.

SUMMARY

In a further analysis of the secretions of surgical maggots, ammonium bicarbonate has been found present in comparatively large quantities. With the aid of a number of physicians and surgeons this product has been tested clinically and found to have marked healing properties similar to the other two maggot products, allantoin and urea. Ammonium bicarbonate is inexpensive and is easily prepared for use in solution form. It was applied to purulent wounds as a 1 or 2 per cent sterile solution on gauze packs. The occurrence of this compound in maggot secretions is associated with the presence of the enzyme urease in maggot tissues. The blowfly *Phormia regina* was the species used.

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CASE REPORTS

TERATOMA OF THE SPERMATIC CORD; CASE REPORT WITH A CONSIDERATION OF THE PROLAN TEST*

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NEOPLASTIC tumors of the spermatic cord are rare; there are about 200 recorded cases. Of the malignant tumors, some form of sarcoma is the most common, while the teratoma is seldom encountered, although it is difficult to say how many actually have been reported. MacKenzie groups them as "embryonal tumors," including in this classification the dermoid teratoma, myxosarcoma, fibromyosarcoma, etc. Thompson in his review of tumors of the spermatic cord mentions no other cases of teratoma than the one reported by Rubaschow in 1926. Hinman and Gibson state that "analysis of cases reported as mixed tumors and teratomas of the cord reveals a confusion of terminology and lack of detail which in many cases casts doubt on their authenticity." With this we concur.

We prefer to reserve the term teratoma for those tumors which contain tissues derived from any or all three germinal layers, with at least two present. In contrast to teratoid tumors, the various types of sarcoma, such as the myxoliposarcoma for example, represent true connective tissue tumors, derived from one germinal layer, the mesoderm. A tumor resembling a sarcoma histologically may result from the one-sided development of the mesothelial elements of a teratoma, but careful search of the specimen should demonstrate the products of one or both of the other layers.

In contrast to the relative rarity of teratomas of the spermatic cord, teratomas of the testicle are common, and a great deal of work has been done in the biologic assay of the hormones associated with this group of tumors. Zondek in 1930 was the first to report the results of tests for prolan A in the urine from a patient with a teratoma of the testicle. Ferguson, Cutler, and Owen have published the results of further studies in this field.

The case of teratoma of the spermatic cord which we are reporting is of special interest not only because of its rarity, but because of the application of the qualitative test for prolan on several occasions. It seems reasonable to assume that there is no more important difference biologically than there is histologically between a teratoma of the testicle and one of the spermatic cord, and that therefore the application of prolan tests to tumors of the spermatic cord should be of equal diagnostic and prognostic value. For those who are not familiar with these tests, it may be of interest to briefly state the current views regarding them.

Two hormones are concerned: prolan A (F.S.H. or follicle-stimulating hormone) and prolan B (A.P.L. or anterior-pituitary-

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like-hormone). Normally prolan A is found in the urine at various times during the menstrual cycle. It may also be found in the urine from the normal male, but in such small amounts (i.e., below 100 mouse units per liter) as to be demonstrable only by the most sensitive of the biologic tests. When, as a result of orchidectomy, ovariectomy, menopause, irradiation of the testicles, cerebral tumors, etc., the hormonal balance of the body is disturbed, markedly increased amounts of prolan A may be found in the urine due to hyperactivity of the anterior pituitary gland. Prolan B, on the other hand, is not found in the normal individual. It is present in large amounts in the urine of pregnant women, especially during the first three or four months of pregnancy. It is believed to be elaborated by the placenta, probably by the cells of the chorion. It is the hormone concerned in positive prolan tests of patients with teratoid type of tumors, when they contain cells like chorionic epithelium. Urine from cases of chorionepithelioma contains, as might be expected, the largest amounts of prolan B; up to 100,000 and more mouse units per liter have been found. In brief, it may be said that a positive prolan test in a patient with a testicular or spermatic cord tumor is indicative of an immature teratoma. The reappearance of a positive test following a negative one in a treated case may be due to recurrent disease (either local or metastatic) or to hormonal imbalance as a result of the orchidectomy or irradiation of the genital area. Cases with recurrent disease generally give larger amounts of prolan or increasing amounts on successive tests, as contrasted with relatively low or stationary levels in patients with mere hormonal imbalance.

An American laborer, aged 72, was admitted June 27, 1935 with a complaint of swelling of the right side of the scrotum. Six months before admission he noticed enlargement of the testicle upon that side and there followed a rapid and progressive increase in size. Some relief was obtained from the wearing of a suspensory, but when the mass became quite large, hard, and tender, a physician was consulted and hospitalization was advised. The patient stated that he had lost 16 pounds in weight. He reported also that he had never had a testicle upon the left side. He was married and had had two children. There was a record of Neisserian infection many years before. Otherwise the history was unimportant.

Examination found a well-nourished man of 72, apparently in good general condition. The right side of the scrotum was markedly enlarged and contained a freely movable, nontender, coarsely lobular mass. It did not appear to be adherent to the scrotal skin. The lower pole of the tumor was soft and fluctuant and capable of transillumination. The upper pole was sharply defined and above it, a somewhat thickened cord could be felt at the external ring. There were no enlarged glands in the groins except for a few small nodes in the right inguinal region. The left testicle was absent. No abnormality was found on abdominal and rectal examination. *X*-ray films of the chest revealed no evidence of metastatic disease. The blood Hinton test was negative, and the test for prolan in the urine was positive.

Although the advanced age of the patient rendered the clinical picture unusual, we believed that we were dealing with a rapidly growing tumor of the testicle, probably malignant. In accordance with our routine procedure, therefore, in such cases, high-voltage deep *x*-ray therapy was given as the first step in treatment. The anterior and posterior aspects of the scrotum received 1200 R units each. No demonstrable regression of the tumor was noted, and one month after the completion of the *x*-ray series, a right orchidectomy was performed under spinal anesthesia.

A small oblique incision was made in the groin on the right side above and parallel with Poupart's ligament, avoiding the region of the tumor. A few small inguinal lymph nodes were encountered and removed; one of them, examined by frozen section, did not show malignant disease. The spermatic cord was freed by blunt dissection after dividing the external oblique fascia in the line of its fibers, and the cremaster muscle. The cord was carefully freed up to the internal ring, and palpation through the ring along the external iliac artery detected no nodes in this region as far as the finger could reach. The cord was then doubly ligated at the internal ring with No. 1 chromic catgut, and

divided with high-frequency current distal to the ties. At no time was a clamp placed upon the cord. The distal stump of the cord and the testis was 3.5 cm. in diameter, composed of grayish-yellow, semi-translucent tissue with yellowish-white strands and scattered brownish

FIG. 1. Photomicrograph of tumor showing undifferentiated cells and fibroblastic portions. (× 300.)

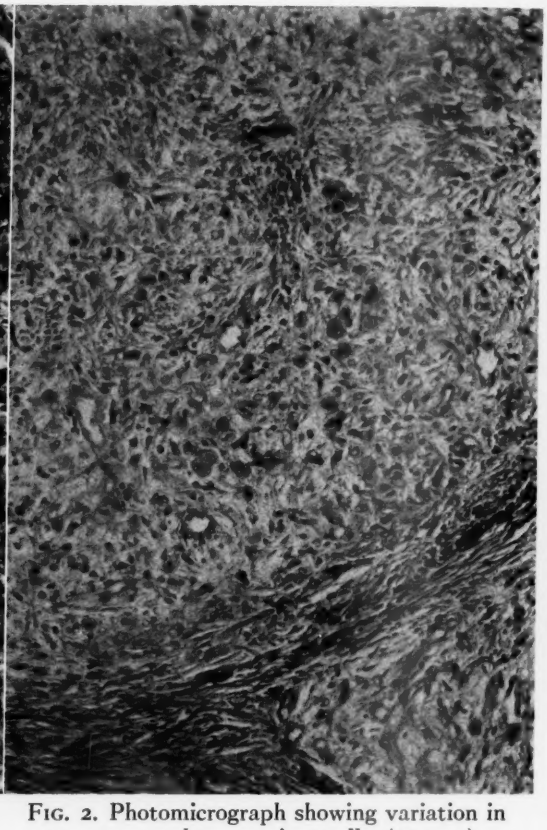

FIG. 2. Photomicrograph showing variation in structure and tumor giant cells. (× 200.)

scrotal tumor were then carefully enucleated, chiefly by blunt dissection, after enlarging the incision downwards onto the anterior wall of the scrotum. The wound was closed in layers and the patient left the operating room in good condition.

We wish to emphasize the importance of the careful and gentle division of the spermatic cord at the level of the internal ring, before the scrotal contents are disturbed in any way, in all cases of orchidectomy for testicular neoplasm.

Pathologic Report. About 4.5 cm down from the upper cut end of the cord was a well encapsulated, oval tumor, measuring 11 × 8 × 5.5 cm. This was fairly firm and somewhat tense. The vas deferens swung over the surface of the tumor to the testis without being involved in the tumor though the various sheaths of the cord appeared to be incorporated in the capsule.

The testis and epididymis were soft and definitely separated from the tumor. The pigmentation. The tunica vaginalis was thickened and there was a hydrocele about 4 cm. in diameter. The epididymis was negative.

On section the tumor was soft, grayish-brown to yellowish-white, with fibrous strands radiating from a rather fibrous center toward the periphery.

A mass of fibrofatty tissue 3 cm. in diameter containing several small resilient lymph nodes was present; this measured up to 0.6 cm. in diameter. On section the nodes were somewhat fibrotic and dark yellowish-gray.

The tumor was loose textured, with numerous large, ill-defined cells, some of which were multinucleate. Throughout, the general groundwork of the tumor was made up of immature spindle-shaped cells varying markedly in size and having a variable amount of very loose intercellular fibrils adjacent to them. In some places fairly dense strands of collagen with well-formed fibroblasts were present. Irregularly scattered among these spindle cells were

large, rounded to elongate, or even stellate, cells having either a single large irregular nucleus or multiple nuclei. The cytoplasm contained numerous small granules or, at times, definite myofibrils with cross striations. Here and there a few of the larger of these cells were vacuolated, with a definite spider web arrangement of the myofibrils.

A moderate number of vacuolated cells resembling immature fat cells were present and rare adult fat cells occurred. In some regions close-packed spindle cells with elongate, blunt-ended nuclei were present. Intercellular substance did not occur between these cells, which apparently were smooth muscle cells. Here and there were some foci of small ill-defined, close-packed, polyhedral cells. Mitoses were very rare in all types of cells. Rare foci of lymphocytes were noted, chiefly in relation to vessels.

The lymph nodes were slightly fibrotic, the epididymis negative. The testis tubules were atrophied. Large masses of compact polygonal cells with round nuclei contained scattered chromatin. Some yellow-brown pigment granules were present. The wall of the hydrocele was composed of fibromuscular tissue containing smooth muscle. Slight lymphocytic infiltration was observed.

Pathologic diagnosis was teratoma of spermatic cord, predominantly mesenchymal; hyperplasia of testicular interstitial cells; negative nodes.

The surgical convalescence was quite uneventful. Two weeks after the operation no prolan was found in the urine. Three weeks after orchidectomy deep *x*-ray therapy was resumed and 1200 R units were given to the anterior and posterior aspects of the pelvis. Somewhat less treatment was given than had been planned because of the onset of diarrhea. The patient was discharged to the out-patient clinic, September 22, 1935.

He was seen one month later when he reported that he had gained 11 pounds and was back at work. He failed to return to the Clinic until April, 1936, at which time it was found that the prolan test was again positive. The general condition was good and the examination was satisfactory, except that in the right upper quadrant of the abdomen there was a vague suggestion of a mass. The abdomen was quite full in this case and difficult to palpate accurately. Readmission to the hospital was advised because of the prolan test, and because of the possibility of recurrent disease in retroperitoneal glands.

Deep *x*-ray therapy was given in June, 1936.

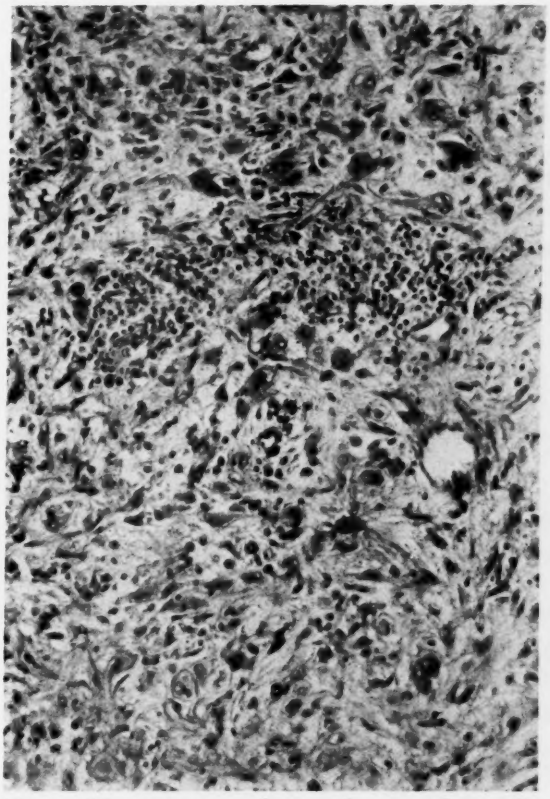

Fig. 3. Myxomatous regions and tumor giant cells. (× 300.)

The right and left sides of the abdomen were treated, anteriorly and posteriorly, and 1200 R units were given through each portal. *X*-ray films of the chest were negative. The patient left the hospital June 24, 1936. The next prolan report on July 27 was negative.

It should be emphasized that in our routine management of cases of malignant disease of the testicle, usually in much younger individuals and with much more definite pathologic pictures, we consider the fields for deep therapy to include the chest and neck as well as the abdomen and pelvis. A negative *x*-ray film does not preclude the possibility of active disease beginning in the lungs and mediastinum. In the case under discussion, the advanced age of the patient and the unusual character of the tumor, together with the lack of any definite evidence of its recurrence led to a modified program of treatment.

The next out-patient visit was September 23, 1936. The patient reported that he had been quite well and he had no significant complaints.

At follow-up visits two and five months later there was no change in his condition, and no evidence of recurrent disease. The prolan test carried out on December 5, 1936 was positive.

He was readmitted to the hospital on March 2, 1937. He had gained 20 pounds during the previous six months. He was thoroughly studied at this time. Examination of the upper gastrointestinal tract by fluoroscopy showed a displacement of the lower esophagus which caused some delay to the passage of the barium, but produced no deformity in outline or in the pattern of the mucous membrane. Extrinsic pressure by a tumor mass lying outside the esophagus was considered. However, a film of the chest showed the lung fields to be clear. It was finally decided to irradiate this area and the patient was given 1200 R units each to the lower mid-chest and right upper abdomen. Clinical examination revealed no evidence of local or metastatic disease except the questionable area above. A barium enema was negative for disease in the colon. *X*-rays of the pelvis and lumbar spine showed only arthritic changes. A Graham test showed no filling of the gall-bladder with dye and was interpreted as indicating an abnormal gall-bladder. This, perhaps, was the explanation of the increased resistance to palpation previously noted in the right upper quadrant and the suggestion of a palpable mass in that region.

The patient was discharged twelve days after admission. A week later, March 18, 1937, the prolan test was reported as slightly positive. Two months later he was readmitted to the hospital for a brief stay, and reëxamination of the esophagus at this time showed the same deviation to the left, and no change in the lung fields. No treatment was given. The prolan test, repeated on June 1, 1937, was positive.

The patient did not report to the clinic again until March 9, 1938. At that time he had no complaints of any kind and weighed 5 pounds more than when he entered the hospital. Examination showed no evidence of recurrent or metastatic disease. His urine was tested for prolan and was negative.

Since quantitative determinations were not done we cannot state definitely that the various positive prolan reports following operation were not due to recurrent disease. However, at his last visit to the clinic, over two and one-half years after his operation, no clinical or biologic evidence of disease could be found, and we believe we are justified in assuming that the previous positive tests were due to hormonal imbalance caused by hyperactivity of the pituitary following castration.

SUMMARY

1. The report of a case with a true teratoma of the spermatic cord, clinically free of disease for over two and one-half years is presented.

2. The significance and value of the determination of urinary prolan in spermatic cord tumors is briefly discussed.

The patient was last seen in the Urological Clinic on August 2, 1939. He had no urinary complaints. His only difficulty was edema of the lower extremities which could be explained on a cardiorenal basis. There was no clinical evidence of metastases.

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TORSION OF THE SPERMATIC CORD

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THE importance of an early accurate diagnosis and the prompt institution of surgical treatment, and the increasing frequency of recognition of torsion of the spermatic cord, warrants a brief view of the salient features and the report of a characteristic case.

A review of the recent literature of torsion of the spermatic cord discloses a considerable discrepancy between the reported and the actual incidence of the condition. In a recent painstaking review of the literature, Abeshouse[1] states, that up to January 1, 1936, there were 347 cases reported; consequently, the condition is relatively rare. In 156 cases he found only twenty-four in infants less than 1 year of age.

Torsion of the spermatic cord is caused by a sudden axial rotation or twisting of the spermatic cord. The blood vessels of the cord are constricted, resulting in an acute circulatory embarrassment in the testis and adnexa, producing local, and occasionally general symptoms. The condition is described as torsion, volvulus, strangulation, gangrene or infarction of the testicle. The term torsion of the spermatic cord is more descriptive of the pathologic process involved.

Torsion may occur at any age, but is most frequently observed in the first two decades of life. It is found as often on the left as on the right side.

The etiology has not been definitely determined. It is generally agreed to be due to some defect in the anchoring of the testicle and epididymis to its bed. The two essential factors involved, upon which the pathology is dependent, are, (1) hypermobility of the testicle, due to a congenital or acquired anatomic abnormality of the testis or its adnexa—this is considered the chief predisposing factor; and (2) an internal or external force resulting in strong contraction of the cremasteric muscle, which is considered the chief exciting factor.

The mechanism of torsion varies with the anatomic structures involved, whether intravaginal and extravaginal. In the intravaginal, the type commonly observed, the twisting of the cord lies entirely within or beneath the tunica vaginalis. The testicle and the epididymis, and not the tunica vaginalis, are involved in the process. In the relatively rare extravaginal type which usually occurs in an undescended or intra-abdominal testis, the twist lies outside the tunica vaginalis and involves this structure as well as the testicle and epididymis. The number and direction of the twists in the cord vary. The degree of torsion may be 90 to 360 degrees. The direction of the twist is usually clockwise on the right and counterclockwise on the left.

The pathology found is the result of obstruction or occlusion of the spermatic veins by the twist in the cord. Early, the testis and epididymis are congested and hemorrhagic; later there is a characteristic hemorrhagic infarction and aseptic gangrene. Atrophy or suppuration may ensue, and a complete disappearance of the testis and epididymis often follows.

The symptomatology is not pathognomonic but is very suggestive, and is directly attributable to the acute circulatory disturbance resulting from the torsion. Usually the following symptoms are found:

1. The onset is sudden with severe pain in the testicle, usually accompanied by nausea, vomiting and mild shock.

2. Swelling of the testicle and epididymis with redness and edema of the skin either in the scrotum or inguinal canal is noted.

3. The twist in the cord may be palpated.

4. Pain is increased on elevation of the testicle (Prehn's sign).

5. There is rotation of the epididymis to a lateral or anterior position.

6. The scrotal contents are retracted upwards.

7. Mild general or constitutional symptoms occur.

8. The leg on the affected side is held in flexion.

9. There is no impulse on cough, or enlargement in size upon crying of the irreducible tumor.

In torsion of the incompletely descended testicle, the accompanying hernial sac or peritoneum in the region of the ectopic testis may become irritated or inflamed and tense, giving rise to all the symptoms of early strangulated hernia. Palpation of the involved structures offers no aid in diagnosing such cases. In addition to the acute type above described, a subacute and a chronic or recurring type is also occasionally seen.

The differential diagnosis is particularly important because of the obvious difference indicated in treatment. Torsion must be differentiated from:

1. Strangulated inguinal hernia which usually occurs at a later period of life. Its course is of rapidly increasing severity, the general systemic and intestinal symptoms are usually more severe than in torsion, although the local symptoms may be identical. The two conditions may coexist.

2. Acute orchitis, where the pain is usually not so severe, the onset gradual, and the swelling more extensive.

3. Acute epididymitis, usually gradual in onset. Other evidences of a local infectious process may be found in the urine, urethra, prostate, and vas deferens, which are absent in torsion.

4. In acute hydrocele or hematocele the pain is not so severe as in torsion, there is no upward retraction of the scrotal mass, and transillumination is possible if the fluid is not too bloody.

5. Tumors of the spermatic cord or inguinal glands, because of slow onset, offer no diagnostic difficulties.

6. Suppurative inguinal adenitis is usually gradual in onset, the pain is not so severe, and careful search reveals a local infectious process responsible for the adenitis.

The prognosis is invariably good. Not a single fatal case has been reported.

Treatment must be promptly instituted and depends upon proper recognition of the true nature of the disease. Gangrene or atrophy occurs in about 85 per cent of cases not relieved by immediate operation. Prophylaxis aims to correct the predisposing causes of torsion, namely, undescended testis and hypermobility of the testis. It consists of the giving of anterior pituitary-like hormone in cases of undescended tests. If torsion actually has occurred, detorsion must be accomplished. Non-operative detorsion of the unexposed testicle is unsatisfactory and does not prevent recurrence.

Operative treatment is either (a) detorsion and orchidopexy, or (b) orchidectomy. The former represents the ideal form of treatment and offers the greatest chance for preserving the testis; it consists of the transposition of the testicle into the scrotum if undescended and of fixation or anchoring of the testicle posteriorly to prevent later recurrence of torsion. Orchidectomy is the operation of necessity and is indicated in those cases presenting gangrene of the testicle and epididymis or a persistent circulatory disturbance.

CASE REPORT

R. S., age 4 months, was admitted to the Children's Hospital November 11, 1937. He had been seen in the office one hour earlier upon the complaint of his mother that he was irritable, held his left thigh in a flexed position, and had a hard lump in the left groin. These symptoms had appeared about eighteen hours previously along with loss of appetite. There had been no vomiting, the morning stool was normal, and no urinary disturbance was pres-

ent. Pain was apparently severe, as the infant cried almost continuously.

Examination showed a rectal temperature of 99.5, pulse 120, respiration 24. The left thigh was held in a flexed position, and attempts to extend it resulted in an increase of pain. There was spasticity of the musculature of the entire left lower quadrant. In the left inguinal canal, at the level of and just below the internal ring, a hard irreducible mass was felt, very firmly adherent to the underlying structures, which evidenced no impulse on cough, and became no larger with crying of the infant; it was very tender to touch. The skin overlying the mass was congested and edematous; the mass measured about 1½ inches long by 1 inch wide. The testicle could not be definitely palpated in the left scrotum, but was palpated in the right. The urine was negative. The leucocyte count was 19,600 with 68 per cent polymorphonuclears.

Preoperative diagnosis of (1) strangulated left inguinal hernia or (2) torsion of left spermatic cord was made. Operation was performed within two hours from the time the patient was first seen and within twenty hours of the onset of symptoms.

Under ether anesthesia an incision was made over the mass in the left inguinal region, cutting through a very edematous skin and opening the left inguinal canal. A blue domed mass was uncovered, tightly adherent, about 1½ by 1 inch in diameter; the cord was not found to extend below this mass. The thick walled sac surrounding the mass was completely freed and gently opened, considerable dark bloody serum was evacuated, and a bloody gangrenous mass exposed. This was found to consist of the testicle, which looked like an organized blood clot, attached to its cord, which had two complete twists in it in a clockwise direction. As the testicle was in a hopeless condition, the cord structures were isolated, ligated separately, and the testicle and involved portion of the cord resected. The sac communicated with the general peritoneal cavity but contained no bowel; the sac was ligated and transfixed and the usual Halstead closure made. The patient made an uneventful recovery and was discharged from the hospital nine days later.

Pathologic Report. The testicle and epididymis were swollen to about twice normal size, were softer than normal, bluish black in color and the consistency of a blood clot.

There were many extensive confluent areas of extravasated blood filling the interstitial spaces. The blood vessels revealed considerable enlargement of the lumina which were crowded with red blood cells. There was also considerable extravasation of blood in the ducts of the epididymis. The testicle showed very extensive degenerative changes and there was almost a complete disappearance of the nuclear structure of the spermatogenic cells. There were also disseminated necrotic areas throughout the entire interstitium. The capsule appeared moderately thickened and a slight amount of fibrin deposit was noted on the tunica vaginalis testis.

SUMMARY

A brief review of the interesting factors in the anatomy, diagnosis and treatment of torsion of the cord has been given and a case report added.

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MUCOCELE OF THE APPENDIX*

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CYSTIC dilatation of the appendix was first described by Virchow[1] in 1863, and was given the name "mucocele" by Feré[2] in 1877. To date approximately 400 cases have been described. Dodge[3] collected 142 cases up to 1916, and Weaver[4] in 1928 was able to add 26 additional cases, including two of his own. Castle[5] collected post-mortem statistics, finding twenty-nine mucoceles of the appendix in 13,158 post-mortem examinations, an incidence of approximately 0.2 per cent. Dannreuther[6] reported eight cases in a series of 8,457 appendectomies at the New York Post-Graduate Hospital. Mayo and Fauster[7] record seventy-six cases out of a total of 31,200 appendectomies. Jirka and Scuderi[8] found an incidence of 0.23 per cent in surgically removed appendices at the Cook County Hospital, as compared to an incidence of only 0.043 per cent in an almost equal number of autopsy specimens, indicating that symptoms are severe enough to lead to operation in the majority of cases. The greatest incidence was six cases in 400 autopsies (1.5 per cent) reported by Ribbert.[9]

The etiologic factor as given by Deaver,[10] Kelly,[11] and others is the local obliteration of the lumen of the appendix with cystic dilatation taking place distal to the site of the obstruction. Phemister[12] states that there is a direct relationship between the development of a mucocele and the normal involution of the appendix. This belief is based on the fact that most cases occur after the age of 35 years when retrogressive changes and obliteration of the appendiceal lumen take place. However, he states that the appendiceal lumen need not be completely obliterated. The pseudomucin escapes into the cecum, a condition demonstrated roentgenologically by Vorhaus[13] and Lifvendahl.[14] A patent lumen was demonstrated in my second case.

Mucocele involving both an ovary and the appendix was described first by Bailey[15] and later by Ries[16] and others. Eden[17] and Rathe[18] have recorded cases in which pseudomyxoma peritonei secondary to ruptured ovarian cysts was found at the first operation and a cystic appendix was removed at a later date. These occurrences of a mucocele of the ovary and the appendix in the same patient have been frequent enough to cause one to speculate as to the possibility of some other etiologic factor. Further argument in favor of other than obstruction as an etiologic factor is the occurrence of mucoceles involving a portion only of the circumference of the appendiceal wall.

While most cases occur after the fourth decade, they are by no means limited to this age. Norment[19] found the average age of patients with mucocele of the appendix in a large series to be 41 years. His youngest patient was 4 years old and the oldest 65. He found the ratio of males to females to be 2 to 1.

The pathologic features are characteristic. The tumor varies in size from a small cyst about 1 cm. in diameter to the size of a man's head, as reported by Neuman.[20] The shape varies with the size and the extent of the appendix involved. It may be oval, round, cylindrical, curved, nodular, club-bed or sausage-shaped. The content is usually thick and gelatinous, but may be watery, and a few cases have been reported in which the content resembled fish eggs.[21–22] Clinical tests show it to be pseudomucin. The entire appendix may be involved and the base may project into the cecum so as to make removal difficult.

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The symptoms are not diagnostic and may be entirely absent. About half of the patients have vague distress in the right lower abdominal quadrant. In one-fifth of the cases reported by Mayo and Fauster[7] a mass was palpable. This palpable mass usually leads to the diagnosis of ovarian cyst or a lesion of the bowel. Roentgenologic evidence is not diagnostic. Only two cases have been diagnosed preoperatively.[13–23]

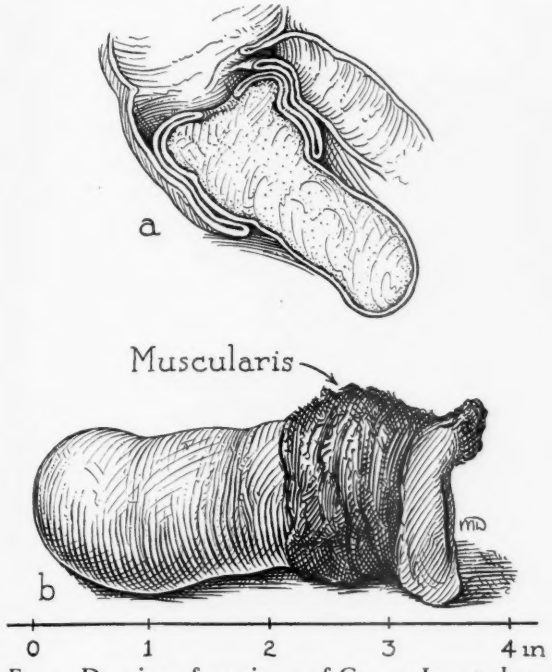

Fig. 1. Drawing of specimen of Case 1. Insert shows invagination of base of appendix into cecum.

The most serious complication is rupture into the peritoneal cavity with development of pseudomyxoma peritonei. Werth[24] first described this condition arising from a mucocele of the ovary, and Fraenkel[25] in 1901 was the first to show pseudomyxoma peritonei arising in the male from the rupture of a mucocele of the appendix into the peritoneal cavity. Acute inflammation of the appendix superimposed on a mucocele may occur as in a case reported by Christopher,[26] and as in my second case and in a few others.

CASE REPORTS

Case 1. The patient, a white male 65 years of age, had never complained of any discomfort referable to his abdomen. Six weeks previous to being seen by me he had a right inguinal hernia repaired. A firm white mass was palpated in the region of the cecum, but could not be delivered. A diagnosis of carcinoma of the cecum was made at the time of the operation, and after recovery from the herniotomy, he was referred to me for a bowel resection.

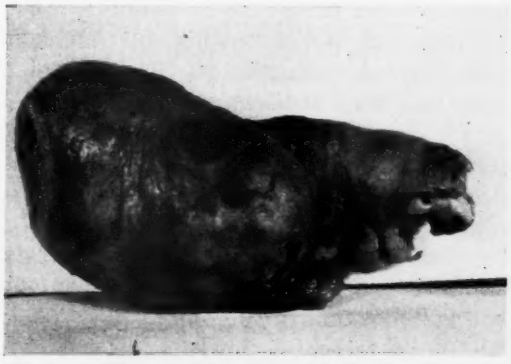

Fig. 2. Photograph of appendix in Case 11.

The patient was well developed, well nourished, and had not lost any weight. No gross or microscopic blood was present in the stools when on a meat-free diet. A mass was palpable in the region of the cecum. On *x*-ray examination a filling defect of the cecum was noted, suggesting that the diagnosis of carcinoma of the cecum was correct.

At operation a mucocele involving the entire appendix was found. The appendix was erect, firm and its base projected into the cecum so that about 25 to 30 per cent of its length was surrounded by the wall of the cecum. There was no evidence of pseudomyxoma peritonei.

The entire cyst was removed by enucleating it from the cecum. Since closure of the defect in the cecum would have compromised the ileocecal valve, a large Pezzer catheter was placed in the cecum and brought to the outside of the abdomen through a stab wound.

The patient made an uneventful recovery, and the fistulous tract to the cecum closed spontaneously after removal of the catheter.

Pathology. The appendix was 10 by 5 cm. (after fixation), sausage-shaped, and tensely distended. The distal two-thirds was covered with smooth and glistening peritoneum, while in the proximal third the muscularis was exposed. The color was white with a faint tinge of pink. A small amount of thick mucus-like material escaped from the cut end.

Since the appendix was to be preserved as a museum specimen, no sections were taken for microscopic study.

Case II. A male 60 years of age had felt "uncomfortable in the lower abdomen" for a week previous to consulting his physician. On the day of admission to the hospital the patient had been nauseated and had vomited once. He complained of a constant pain in the lower abdomen to the right of the midline. Anorexia was present. A history of auricular fibrillations was given.

Physical examination revealed a temperature of 100.6 degrees, pulse 96. The blood pressure was 122/88 m.m. of mercury. The patient obese, florid-faced. A fairly constant extrasystole was present. The abdomen was obese but not distended. Tenderness was noted on pressure in the right lower quadrant of the abdomen, but not in other parts of the abdomen. Increased muscle tone was present in the right lower quadrant of the abdomen. No mass was palpable through the abdominal wall. Pressure in the right flank did not produce pain. On digital rectal examination a tender mass was palpable high in the pelvis on the right side. On auscultation of the abdomen peristaltic sounds were heard throughout, but were diminished in frequency over the right lower quadrant. No obstructive borborygmi were heard. The leucocyte count was 14,550. The urine was normal except for a trace of bile which persisted throughout the patient's stay in the hospital.

A preoperative diagnosis of acute pelvic appendicitis was made. At operation free fluid was found in the peritoneal cavity. The terminal ileum and cecum were hyperemic and bound down by fibrinous adhesions about a large firm mass extending over the brim of the pelvis. This mass was a large bulbous appendix, gangrenous in part, while other portions were either semi-transparent or white like scar tissue. The wall of the proximal half of the appendix was hyperemic and greatly thickened and indurated, the induration involving the cecum at the base of the appendix and causing difficulty in removal. The cecum was closed after removal of the appendix without obstructing the ileocecal valve. There was no evidence of pseudomyxoma peritonei. The abdominal wall was closed without drainage.

The postoperative diagnosis was infected mucocele of the appendix.

The convalescence was uneventful save for an auricular fibrillation which was controlled by quinidine and a singultus which was controlled by barbiturates.

Pathologic Examination. The appendix measured 10 by 4.5 by 2.5 cm. The distal end was bulbous and enlarged to a diameter of 4.5 cm., and filled with bloody exudate and mucus. The wall of this portion was mostly thin with thickened white areas. After removing a section for microscopic examination, a gelatinous-like mucus was found adherent to the wall of the bulbous portion. The lumen of the appendix was patent.

Microscopic examination revealed moderate infiltration of the walls by both neutrophiles and round cells. A marked fibrosis of the mucosa and submucosa indicated a process of long standing. Both the lymphoid tissue and the mucosa were almost completely replaced by fibrous tissue. Instead of normal appearing glands, the structures had the form of papillary projections from the inner wall. The epithelium about the tips of these projections was mostly of the mucous type.

COMMENT

Symptoms of mucocele are frequently severe enough to cause removal of the appendix, although a preoperative diagnosis is a rarity. The theory that the lumen of the appendix must be blocked proximal to the mucocele and that the content must be sterile is not always correct, as illustrated by the second case reported in this paper.

The concomitant presence of a mucocele of the appendix and of an ovary suggests the possibility of a developmental defect or congenital precursor. Rupture of a mucocele of the appendix or ovary may give rise to pseudomyxoma peritonei.

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MESENTERIC THROMBOSIS—OPERATION—RECOVERY*

REPORT OF TWO CASES

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THROMBOSIS of the superior mesenteric vessels is an infrequent cause of intestinal obstruction. McIver, in an analysis of 335 cases of intestinal obstruction, found that only 3 per cent of the obstructions were due to occlusion of mesenteric vessels. Donaldson and Stout have contributed to the pathology of this affection and by their careful clinical observations and animal experimentations have differentiated between arterial and venous mesenteric thrombosis. They point out that with venous thrombosis the muscular structure of the intestinal wall remains viable for a considerable period of time, whereas in arterial thrombosis, gangrene of the intestinal wall comes on immediately.

Both conditions need surgical intervention but it is more urgently required in the arterial type. The mortality without surgery in thrombosis of the superior mesenteric artery is 100 per cent. The occasional reports in the literature of recovery without operation must have been examples of thrombosis of the superior mesenteric vein. The mortality rate even with operation is extremely high. It is estimated by various authors at from 50 per cent to 90 per cent. The opportunity recently presented of observing and successfully operating upon two patients with this most fatal of all abdominal emergencies prompts the recording of their case histories.

CASE 1. A 60 year old American housewife was admitted to the Henry Ford Hospital as an emergency July 8, 1935, because of severe abdominal pain. She had been seized with sudden severe generalized abdominal pain thirteen hours previous to admission following the taking of food. The pain was intermittent in character and had gradually increased in severity. Vomiting had been present since the onset and had recurred at intervals of twenty to thirty minutes. The vomitus at first had consisted of gastric contents, but at the time of admission was mostly mucus. The pain was so severe that morphine had been administered by her family physician. There had been no bowel movement since the pain began but she had passed flatus.

The past history had no bearing on the condition. There had been no operations, no suggestion of cardiovascular disease, no previous attacks of abdominal pain.

The abdomen was tense throughout and there was pronounced muscular spasm all over, most marked in the left lower quadrant. There was no distention. The temperature was 97.8°F., the pulse 88, respirations 20. W.B.C. 16,500, with polymorphonuclears 89 per cent. Blood pressure was 118/80.

A tentative diagnosis of an acute surgical condition of the abdomen was made, with twisted ovarian cyst, ruptured peptic ulcer and acute pancreatitis being considered as possibilities. General supportive measures, including the intravenous administration of 10 per cent glucose, were instituted. The persistence of severe pain and continuation of the vomiting suggested intestinal obstruction so strongly that operation was advised.

Laparotomy was performed within twenty-four hours of the onset of the pain. Under spinal anesthetic a midline infra-umbilical incision was made, reflecting the right rectus mucle outward. When the peritoneal cavity was opened, several loops of black gangrenous small bowel presented but there was no undue amount of peritoneal fluid. The gangrenous loops of intestine were not dilated. The involved area of bowel was sharply demarcated at a point 4 inches from the ileocecal valve, and as the intestine was followed proximally, the amount of gangrene decreased until it finally shaded off into hyperemic and finally normal appearing intestine. The mesentery corresponding to the area of gangrenous intestine was

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thickened and discolored. A segment of damaged ileum 4½ feet in length was resected. The small stump of terminal ileum was ligated and invaginated into the wall of the cecum with a series of purse-string sutures. A mobile cecum made it easy to do an end-to-side anastomosis of the ileum to the cecum.

Recovery from the resection was extremely smooth but hospitalization was lengthened to a month because of the development of a thrombophlebitis of the right leg.

In spite of the removal of 4½ feet of terminal ileum the patient experienced no frequency of bowel movement. Her general health three years after operation was excellent.

Pathologic Report. The diagnosis was mesenteric thrombosis with gangrene of the small bowel. The proximal end of the artery in the involved area of mesentery was lined with a yellowish membrane but was not completely occluded. A section of the arteries of the bowel wall showed that they were patent but thrombotic masses filled the lumen of the venous channels.

Case II. A 25-year old American housewife, six months pregnant, was admitted as an emergency to the Henry Ford Hospital October 7, 1935 because of severe abdominal pain. The pain had come on suddenly a few hours previous to admission. It was continuous, radiating into the back and right flank, and of such severity that morphine was required for its control. There was no vomiting. At first the pain was thought to be due to the onset of premature labor, but there were no accompanying uterine contractions.

There was no distention. The abdomen was diffusely tender to palpation and there was slight general muscle spasm, but the pain and tenderness were more pronounced in the right flank. A right rectus appendectomy scar was present. The temperature was 98.8, the pulse rate 84 and respirations 20. The white count was 18,400 with polymorphonuclears 90 per cent. The ureters were catheterized and pyelograms were made because of pain in the right flank, but the results were negative. The following day the pain persisted, but vomiting did not appear until nearly forty-eight hours after the onset of the pain. A diagnosis of intestinal obstruction was made and operation advised.

Laparotomy was performed forty-eight hours after the onset of the attack. Under ethylene and ether anesthesia, the abdomen was opened through a subumbilical right rectus incision. A large amount of blood stained fluid, estimated at 1,500 c.c. escaped from the peritoneal cavity and an inert mass of gangrenous ileum presented to the right of the uterus, completely filling the wound.

A diagnosis of superior mesenteric thrombosis seemed obvious, but, when an effort was made to bring the diseased loops of bowel up into the wound, it was found that a portion of the involved area was tied down by an adhesion band. This suggested that the band was the cause of the obstruction. However, the extension of the diseased process beyond the area compressed by the band and its limitation to the region supplied by the superior mesenteric artery forced a return to the original diagnosis of mesenteric thrombosis.

The involved area of ileum measured 9 feet in length and its mesentery was also black and gangrenous. The last 4 inches of the ileum were not damaged and there was a sharp line of demarcation between the gangrenous and healthy intestine. The gangrenous ileum and its mesentery were resected. The stump of the ileum was ligated and invaginated into the wall of the cecum by means of a series of purse-string sutures. The cecum was mobilized by incising the peritoneum along the floor of the right paracolic gutter. An end-to-side anastomosis of the ileum to the cecum was then readily done.

Recovery from the abdominal operation was satisfactory but hospitalization was prolonged to five weeks because of the delivery of a stillborn baby on the second postoperative day and the subsequent development of bronchopneumonia.

The patient was inconvenienced by frequent bowel movements for some time but eventually this cleared up and three years after operation, in spite of the loss of nearly one-half of her small intestine, her health was good.

Pathologic Report. The diagnosis of mesenteric thrombosis with gangrene of the small bowel was confirmed. The lumen of the gut was filled with bloody liquid material, the wall hemorrhagic and easily torn. The blood vessels of the mesentery showed thrombi.

COMMENT

The two case histories cited are examples of the truth of the dictum of Boyce and

McFetridge that the most hopeful thing about mesenteric thrombosis is that it can be cured by operation. The outstanding clinical feature of both case histories was the severity of the abdominal pain which required morphia for its alleviation. Vomiting was present in both cases. In Case II it persisted from the onset while in Case I it was a late manifestation of the condition. In both patients, the vomiting was overshadowed by the agonizing pain. This is exactly the reverse of the usual picture of obstructions of the small bowel from other causes, where vomiting is the essential point and pain occupies a secondary position in the symptomatology. The approximately normal temperature and pulse rate negative the presence of infection and the early high leucocytic response indicates tissue death.

Case I is clearly an example of the venous type of mesenteric occlusion, though the terminal mesenteric arteries, while still patent, were secondarily involved.

Case II represents the arterial type because of the rapid onset of gangrene. Section of the diseased mesentery showed that both arteries and veins were involved. The diagnosis of primary mesenteric thrombosis in Case II may be challenged because of the presence of the adhesion band. Points in favor of its inclusion are: The clinical course with late signs of obstruction, non-dilatation of the involved loops of intestine, thrombosis of both mesenteric artery and vein with resulting complete gangrene of the bowel wall and extension of the gangrenous process to the mesentery itself, and finally the pathologic report of mesenteric thrombosis. The finding of a definite line of demarcation between diseased and healthy bowel exactly at the point of anastomosis between the ileocolic and terminal intestinal branches of the superior mesenteric artery appears to clinch the diagnosis of primary mesenteric thrombosis. The presence of the band was probably incidental and of secondary importance.

An interesting and identical verification of a well known anatomic fact was made in both cases. In both instances the terminal 4 inches of the ileum was not involved since this portion of the ileum derives its blood supply from the ileocolic artery and not from the terminal intestinal branches of the superior mesenteric artery. Furthermore, the finding of a mobile cecum in Case I and its utilization for anastomotic purposes suggested the procedure adopted in Case II, viz., mobilizing the cecum and ascending colon and anastomosing the ileum to the cecum rather than subjecting the patient to the further hazard of resection of the ileocecal segment. Resection and anastomosis constituted the procedure of choice as well as of expediency in both cases, because exteriorization would have necessitated mobilizing the entire ileocecal segment. The stump of the terminal ileum was too short to bring up into the abdominal wound.

SUMMARY

Two cases of mesenteric thrombosis are reported. The most outstanding clinical feature was the severity of the abdominal pain. Vomiting was of secondary importance in the symptomatology, thereby reversing the usual picture of small intestinal obstruction. Recovery followed resection of 9 feet of ileum in one patient and 4½ feet in the other.

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A CASE OF PRIMARY LYMPHOSARCOMA OCCUPYING TWO-THIRDS OF THE LUMEN OF THE STOMACH

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IT is generally conceded that the incidence of primary gastric sarcoma is about 1 per cent of all gastric neoplasms.[1,9,10]

Pack and McNeer[1] in 1935 reported nine cases of sarcoma of the stomach, three of which were primary gastric lymphosarcomata. They stated that out of 40,000 cases of benign and malignant neoplasms of all organs treated at the Memorial Hospital, there were 400 cases of malignant neoplasms of the stomach. In that series there were only five cases of sarcoma, two of which were primary gastric lymphosarcomata. They reported a third such case from the New Haven Hospital.

Cheever[2] reviewed 628 cases of gastric tumors treated at the Peter Bent Brigham Hospital, among which there were nine cases of lymphosarcomata.

Cases of general lymphosarcoma which have come to autopsy have not infrequently been found to have secondary metastatic involvement of the stomach. Two such cases were included among those reported by Pack and McNeer.

The first case of sarcoma of the stomach reported in the literature was by Sibley in 1816, quoted by Walton.[3]

Primary gastric lymphosarcoma may occur at any age. Finlayson's[4] patient was 3½ years old. Jones and Carmody's[5] patient was 9 years of age. Di Giacoma's[6] was 65 years old, Gosset's patient cited by Balfour and McCann[7] was aged 85 years.

Sarcoma may grow from any aspect of the stomach. They have been described as intragastric, intramural, and even extragastric in location.

Types of gastric sarcoma reported in the literature are angiosarcoma, spindle-cell sarcoma, neurosarcoma and fibrosarcoma. The latter two are of higher malignancy and occasionally involve the pylorus. Another type called round or alveolar sarcoma is usually infiltrative in character and a less common variety.

Clinically, it is most often impossible to differentiate between carcinoma and sarcoma of the stomach. Symptoms of epigastric pressure, pain, vomiting, hematemesis, tarry stools, anemia and loss of weight are common to both.

Patients between 20 and 35 years of age or less, in whom a large gastric neoplasm is found, most likely are suffering from sarcoma rather than carcinoma of the stomach. In addition to the usual Roentgen examination a gastroscopic examination should be made, preferably with the gastroscope containing the retrograde optical attachment described by Korbsch.[8] This may aid in making a definite diagnosis. Very occasionally a piece of the gastric neoplasm may become dislodged during regurgitation or while doing a gastric analysis. Pathologic examination of the piece of tissue would clinch the diagnosis.

It is generally recognized that when gastric carcinoma can be clinically palpated, it is most often already too late for surgical intervention because of metastases and even direct invasion of the surrounding structures. This is not necessarily so in sarcoma of the stomach. Metastases, when they do occur, appear much later in the disease, and may be present in the perigastric lymph nodes, liver, mesentery, lungs, peritoneum and also in the superficial lymph nodes. When the latter appear, a biopsy may easily confirm the diagnosis.

Lymphosarcoma is radiosensitive. The malignant lymphocytes are sensitive to radium as well as to the Roentgen ray. Desjardins stated that this therapy alone might cure early cases of gastric lymphosarcoma. It would, however, appear to be a dangerous procedure to treat the larger tumors by radiation alone because of possible necrosis, hemorrhage or perforation. Drane[11] advises the administration of medium wave length Roentgen therapy.

FIG. 1. Excised distal two-thirds of stomach showing tumor size of a baby's head which grew from the posterior wall and occupied its lumen.

Most cases reviewed in the literature have not survived operation for more than one year. There have, however, been notable exceptions which have survived and have remained well for many years. Balfour and McCann's[7] patients after gastrectomy lived on the average of eleven months and their longest survival was nine years. Jones and Carmody's[5] case of gastric lymphosarcoma in a boy 9 years old, was reported surgically cured nineteen years after partial gastrectomy. This is the longest postoperative cure of this lesion which has been reported.

CASE REPORT

M. T., 38 years of age, a Greek woman, was admitted to the Misericordia Hospital on February 8, 1930. She was married and had three children. A cholecystectomy and appendectomy had been performed five years previously at another institution. For four months prior to admission to the hospital she had complained of epigastric cramp-like pains which radiated to the interscapular region. These occurred about twenty minutes after meals and lasted for many hours. Nausea, vomiting and eructations were present. Fourteen days before admission she began to have hematemesis soon after taking food. This persisted for seven days. She had two similar attacks of copious bloody vomiting during the ensuing week. The stools were tarry black in color, but there was no diarrhea. The patient had lost

29 pounds within four months and was becoming progressively weaker.

Physical examination revealed the patient to be acutely ill. There was marked pallor and evidence of considerable loss of weight. The abdomen was protuberant. A large tumor the size of a grape-fruit was easily palpable in the left upper quadrant. It was tender and did not move with respirations, but seemed to be attached to the deeper structures. The mass was firm, irregular and extended behind the region of the spleen. The liver was not enlarged and there was no ascites present. The heart and lungs were clinically negative. No enlarged lymph nodes were palpable. The rectum and pelvic organs revealed no abnormality.

Gastric analysis could not be attempted in the presence of gross hematemesis and danger of perforation of the stomach.

Roentgen ray examination revealed an unusual defect in the pars media and pars pylorica of the stomach. There was no evidence of obstruction. The roentgenologist could not be certain whether the tumor was intragastric or extragastric. Clinically, the lesion was thought to be either carcinoma of the stomach or a pancreatic tumor.

Blood count showed Erythrocytes 3,670,000; white cells 13,800; polymorphonuclear leucocytes 80 per cent; lymphocytes 18 per cent; mononuclear cells 2 per cent. The blood pressure was 116/80. Blood chemistry revealed: urea nitrogen 15; creatinine 1; uric acid 3.4; sugar 106 mg. per cent. Cystoscopic examination and pyelography were negative.

Exploratory operation was performed on February 13, 1930. A median epigastric incision was made. Upon opening the peritoneum no free fluid was encountered. The stomach wall was dilated and hypertrophied. An oval tumor the size of a baby's head was found to be growing from the posterior wall of the stomach and occupying about two-thirds of its lumen. A few metastases were present, only in the regional lymph nodes at the lesser curvature.

A subtotal gastrectomy was performed. The upper third of the remaining part of the stomach was closed and a Polya operation with retrocolic anastomosis with the first portion of the jejunum was done. Moderate postoperative shock followed, which was relieved with glucose-saline infusions and medication. A blood transfusion of 600 c.c. of whole blood was given.

The patient rallied after a stormy postoperative course. Soon after operation she was able to take small quantities of easily digestible foods, and she became progressively stronger. She was discharged from the hospital on April 20, 1930.

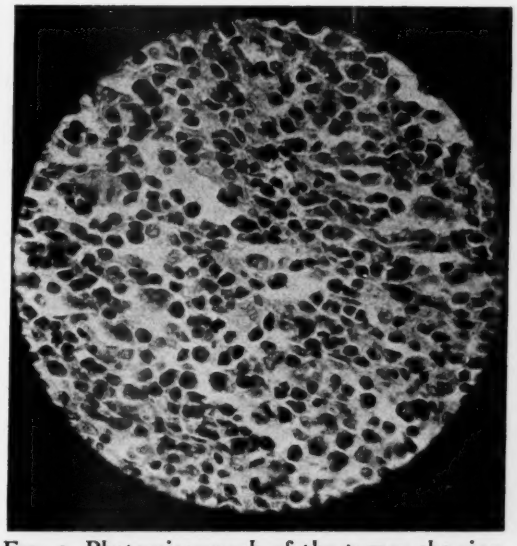

Fig. 2. Photomicrograph of the tumor showing round cells varying in size containing large pale nuclei with numerous mitotic figures. The supporting tissue is scant, delicate and contains few fibrils.

Three weeks after she left the hospital, I was called hurriedly to see her during the night. She complained of severe thoracic pains, dyspnea, cough and hemoptysis, and died suddenly from what clinically resembled pulmonary embolism. No permission for a postmortem examination could be obtained.

Pathologic examination of the portion of the stomach containing the tumor removed at operation was made by Dr. R. C. Schleussner. The specimen (Fig. 1) consisted of a section of stomach measuring 17 cm. × 20 cm. The stomach had been opened along the anterior wall and weighed 580 gm. Arising from the posterior wall was a large ovoid tumor 14 × 9 × 5 cm. It had a broad flat base and its surface was superficially ulcerated. On section it was of uniform grayish white color and was quite friable. The edge of the tumor could be seen to be infiltrating the wall of the stomach beneath the adjoining mucous membrane.

Sections through the main body of the tumor showed that it was composed of round cells about 10 mm. in diameter, with moderate variation in the size of the cells. The nuclei

were large and pale; numerous mitotic figures could be seen. The cytoplasm was scant and irregularly extended in places. There was only a small amount of delicate supporting tissue present, little intracellular brown substance and very few fibrils. The tumor penetrated all coats of the stomach wall and displaced the normal tissue. Numerous tumor cells infiltrated the stomach wall beneath the mucosa at the border of the tumor. The tumor tissue contained many thin walled blood vessels. (Fig. 2.)

SUMMARY

A case of primary lymphosarcoma occupying two-thirds of the lumen of the stomach is reported. This occurred in a woman 38 years old.

Primary lymphosarcoma of the stomach occurs in about 1 per cent of all gastric neoplasms.

The youngest patient with this lesion reported in the literature was 3½ years of age, and the oldest patient was 85 years.

The longest survival after gastrectomy reported surgically cured was 19 years (Jones and Carmody).

Patients with large palpable gastric tumors before middle age should be suspected of having sarcoma of the stomach and not carcinoma.

Subtotal or even total gastrectomy followed by deep Roentgen therapy is the procedure generally followed.

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EPIDEMIC PAROTITIS (MUMPS) AND ACUTE APPENDICITIS

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"EPIDEMIC parotitis is an acute contagious disease characterized by swelling and tenderness in one or more of the salivary glands, by comparatively mild constitutional manifestations and by a tendency in adult males to develop orchitis as a complication."[20] It is caused by a filtrable virus.[11,14] It also may attack the pancreas, mature ovaries, the meninges and the brain. Fatal cases of the meningitic type have been reported.[12] It is not necessary in a case of disease caused by the virus that the salivary glands be involved. Meningo-encephalitis is reported by Montgomery (quoted by Stimson[20]). Orchitis without parotitis has also been reported.[3,9,10]

The incubation period is from twelve to twenty-four days at the probable outside limits.[20]

The disease may be preceded by a slight fever and some chilliness with general malaise and dizziness for twelve to twenty-four hours before the salivary swelling is noted. Pain in and behind the ear and sore throat are also frequent complaints at this time.[20] These symptoms are variable and may be very severe or entirely absent. The duration is from seven days to about three weeks with rare cases extending even longer. Usually the swelling is down in about ten days. Abscess formation does not occur.[20] The duct orifice may be reddened and puffy but normal saliva is grossly present as compared to the pyogenic parotitis of the ascending type with purulent exudate.[7,8] The temperature varies from normal to over 103°F.

Complications in this disease occur usually about four to seven days after the onset. Of these orchitis is the most frequent. This rarely occurs before puberty and is present in about 20 per cent of adults.[20] Sexual activity increases the evidence of orchitis, as demonstrated by French and German authors during the war. They noted lower incidence in soldiers at the front as compared to the incidence at the bases where soldiers had opportunity to gratify their sex desires.[15]

The swelling may be unilateral or bilateral (about 16 per cent).[20] It usually lasts from four to seven days and is accompanied by high fever and occasionally severe systemic reaction. Wolbarst states that the swelling is caused by acute inflammatory reaction in the testicle with areas of groups of seminiferous (convoluted) tubules completely destroyed and distended with exudate. The exudate consists chiefly of polymorphonuclear leucocytes and the phagocytic endothelial leukocytes. The intertubular connective tissue is edematous. The description is taken from report of microscopic sections received during the acute stage by operation.[19]

Atrophy results in about 60 per cent.[19] Sex function is usually regained and complete sterility as an aftermath is exceedingly rare.[20] The epididymis may be involved also. J. D. Rolleston[15] mentions a case of suppuration of the testicle. Here, however, scarlet fever was present at the same time.

Pancreatitis occurs occasionally. It is found more often in adult women and rarely is seen before puberty. It begins about a week after the onset and is characterized by prostration, severe nausea and vomiting and epigastric pain. It usually subsides in four or five days with complete recovery. Sugar is not found in the urine at the time.[20] Possibly with the

blood amylase tests this might be more accurately determined. Rolleston[15] states that diabetes has been reported to follow mumps.

Inflammations of the thyroid, mammary, lacrimal glands, ovaries and prostate also have been reported. The kidneys may show a mild form of diffuse nephritis. Meningo-encephalitis is not very rare. It may vary from a mild form to the severe type which may show signs of encephalitis with delirium and coma and may even be fatal.[12] The spinal fluid shows increased pressure, presence of globulin and a lymphocytosis with from 50 to 1,000 cells. Usually complete recovery occurs after a few days. Deafness may occur due to nerve involvement. This is often permanent.[20]

Simonin in 1903[16] first reported the occurrence of acute appendicitis and epidemic parotitis. Since then cases have been reported by Jaloquier (1909), Gauchier and Swnynghidow (1925), Benassi (1927), Sandler and Finne (1932), and Seelye (1935). Undoubtedly many other cases have been reported which were not noted by the writer as well as many, probably the greater number, which have not been reported at all. Dr. George F. Dick in the Yearbook of Medicine for 1935 notes the increase of appendicitis in epidemics of mumps.

Rosenau and Dunlap reported an epidemic of appendicitis and parotitis at the Culver Military Academy in 1916.[18] There were thirty four cases of parotitis and eight cases of appendicitis. However, the two conditions did not occur in the same individuals. They isolated a streptococcus which gave rise to parotitis and appendicitis in varying proportions in rabbits. In view of the recent work by Johnson and Goodpasture proving that a virus is the cause of mumps, the inference drawn that both conditions were caused by the same organism, a streptococcus, seems questionable.

The few articles obtained on the subject of mumps and appendicitis mentioned Benassi[2] as feeling that the cause of the mumps was also the cause of the appendicitis. His opinion is based on one fatal case occuring in a boy of 18 who developed a bilateral orchitis on the third day after the parotid swelling. Abdominal pain began on the fifth day and continued until his admission to the hospital about two weeks later. At this time he showed signs of advanced peritonitis and died without being operated on. A ruptured appendix with diffuse peritonitis was found at the autopsy. Benassi states that "the appendicitis developed at the height of the parotitis and with some doubt and reserve there is enough evidence to support the following conclusion, that the virus or organism which lodges in Stenson's duct travels to the appendiceal region by way of the digestive tract or by way of the hematogenous or lymphatic system."

Appendicitis in the cases cited began within a week after the onset of the swelling. Pancreatitis, oöphoritis, etc., also begin about the same time. All these would tend to support the idea that there is some connection between epidemic parotitis and acute appendicitis. The few cases reported compared to the number of cases of mumps in a community, however, contradict this hypothesis and would tend to suggest coincidence rather than cause. This is borne out by the medical profession of this vicinity, most of whom have never seen both conditions in the same patient.

Abdominal pain is seen in other of the acute contagious diseases such as scarlet fever,[20] measles, and in anterior poliomyelitis. Appendicitis occurs occasionally during the course of any of the contagious diseases. A direct connection is not generally accepted between the systemic condition and the appendicitis with the exception of tonsillitis and grippe.

CASE REPORT

In March, 1935 the writer was called to see a boy of 14 with acute swelling of the left parotid gland of three days' duration due to mumps. He had been taken with acute pain in the right

lower quadrant twelve hours previously. His temperature was 100 rectally, pulse 88, respirations 20. The abdominal pain came on suddenly without vomiting and with gradual localization over McBurney's area. The pain was severe and continuous.

The past history was negative and physical examination also proved negative aside from the swollen parotid gland and marked muscle spasm and rebound pain over McBurney's area.

A diagnosis of acute appendicitis was made and operation performed under local anesthesia with a few moments of gas and oxygen on opening the peritoneum. There was a moderate amount of cloudy fluid in the abdomen. The appendix was markedly enlarged, covered with fibrin and acutely inflamed. Culture from the abdominal cavity showed Gram-negative bacilli resembling diphtheriods. The microscopic diagnosis was acute catarrhal appendicitis and peri-appendicitis. Convalescence was uneventful.

The second case was seen January 6, 1938, at midnight. The patient, a boy aged 19, had been complaining of pain in the right lower quadrant off and on for about four weeks. It was crampy in character and was not accompanied by nausea and vomiting. During the four weeks period he had also noticed tenderness in the right testicle and stated that his underwear felt tight. He denied any swelling or discharge. There was no history of exposure, and he had no chills or night sweats. During the previous day the pains had become more severe although they were similar to his previous attacks. No frequency or dysuria was reported.

Examination showed muscle spasm and some rebound pain over McBurney's area. The abdomen was otherwise soft and normal. The right testicle was not swollen, but pulling the testicle down elicited pain on the right side. This, however, was not the same pain as that for which attention had been sought. The urethra was normal in appearance and there was no discharge. White count and urinalysis were normal. Despite the negative urinary complaints a flat plate was done the following morning which was negative for stones.

The pain still persisted but the temperature and pulse were still normal. At operation the appendix grossly showed moderate congestion. Postoperatively the temperature rose to 104 although the patient did not look at all ill. On the second day, the temperature was 102. At this time swelling of the right testicle manifested itself. The testicle was elevated and ice caps applied. On the third day the right parotid gland showed a swelling about the size of a large walnut just in front of the ear. Stenson's duct was slightly injected and on pressure clear saliva was noted. The swelling of the gland subsided in two days with the application of ice caps. The temperature fluctuated between 100 and 103 until the sixth day when it dropped to normal. The swelling of the testicle subsided in about a week.

One month after the operation there was definite atrophy of the right testicle. A detailed microscopic examination of the appendix showed evidence of an acute exacerbation of a chronic appendix. The mucosa was destroyed in many areas and there was pus in the lumen. It is difficult to believe that the patient's pain over a period of a month was due to appendicitis. At the same time, however, the period is also rather long for beginning parotitis. This case might be considered as in favor of Benassi's hypothesis.

In a discussion of these cases the question arose whether the second case was actually one of epidemic parotitis. From my past experience[7,8] I cannot differentiate the appearance of the gland and duct orifice from that seen in the hematogenous type of postoperative parotitis. However, I have not noted an orchitis coincidental with the parotitis at any time nor have I been able to find such cases in the literature. Furthermore, atrophy of the testicle due to or coincidental with postoperative parotitis has not been reported. Aside from cases of severe systemic infections, such as typhoid, I find no causes of atrophy of the testes mentioned by Young[21] except mumps, excluding, trauma or pyogenic infection where abscess occurs. Furthermore, in Binghamton we had at the time a widespread epidemic of parotitis with a large number of cases of orchitis in adults. This boy was exposed to mumps and stated that prior to this attack he had never had the disease.

It is my impression that this patient had a low grade infection of the testicle

due to the virus of mumps without salivary gland involvement. It is possible that the anesthetic (ether) and the trauma incidental to operation caused a flare-up in both the parotid gland and the testicle with evident gross pathology. The comparatively mild course of the disease and resulting atrophy of the testicle would tend to substantiate the mumps etiology.

SUMMARY

Two cases of acute appendicitis and epidemic parotitis have been reported. A general survey of the literature and a careful analysis of these cases do not tend to substantiate the theory of Benassi that epidemic parotitis and acute appendicitis are caused by the same organism. It is felt that the condition when found is coincidental.

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RETROPERITONEAL POSITION OF THE ASCENDING COLON

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A CAREFUL search of the literature fails to reveal a case with findings similar to those recorded in this paper, namely the retroperitoneal position of the ascending colon in an adult. Developmental defects and malpositions are frequently met, especially in infants; but many of the bizarre and altogether strange cases pass by unnoticed and consequently remain unreported, because these patients do not have the benefit of radiography or do not come to operation or autopsy.

Among the congenital findings, previously mentioned by other writers, particularly referable to the colon are:

1. Complete or partial absence of the colon.
2. Transposition of the viscera, which may be partial or complete.
3. Stenosis or atresia.
4. Microcolon.
5. Megacolon.
6. Double-barreled colon.
7. Intestinal fistula.
8. Termination of the gut in an umbilical hernia.
9. Diverticula.
10. Associated abnormalities of the mesentery and peritoneum.

It is the consensus of opinion that developmental errors involving the gut are frequently found in babies and children, who often present other congenital anomalies, such as cleft palate, atresia of the urethra, anus or vagina; spinal cord defects causing fecal and urinary incontinence, etc. Malformations and irregular positions of the gut are said to occur frequently in males.

On the evening of April 8, 1938, Miss H. H., 34 years old, was admitted to the hospital. Three days previously she had been taken ill quite suddenly with cramp-like, generalized abdominal pain which occasionally let up, but returned with greater severity. The pain gradually seemed to localize in the lower left quadrant, and upon the day of admission its severity was intense. There was no history of vomiting, though the patient complained of considerable nausea and had eaten little for three days. The day before and on the day of admission she had had no bowel movement. An enema produced no results. The patient had noticed a change in the size of the abdomen shortly after onset of the first abdominal pain. This increased to marked distention upon admission.

About two years before she had been in the hospital for observation for a short period of time, because of some vague intestinal complaint. Otherwise her general health had been fairly good. Her menstrual periods were regular; the last one had occurred two weeks previous. An accident had caused loss of sight in the right eye in childhood. The family history was positive for diabetes mellitus and cardiac disease.

Upon admission temperature was 101 degrees, pulse 140 and respiration 26. The abdomen was markedly distended, approximately to the size of an eight months' pregnancy. Tenderness could be elicited upon palpation of any portion of the abdomen, the point of greatest pain being to the left of the umbilicus. Peristalsis could not be heard. The laboratory findings were quite normal.

The clinical picture apparently pointed to an intestinal obstruction, in spite of the absence of vomiting and the normal blood count. The roentgenologist verified this diagnosis, and operation was deemed necessary. The patient was operated upon that night under spinal anesthesia.

A midline incision from the umbilicus to the symphysis was made. Opening of the peritoneum produced an overflow of free serous fluid. The cecum lay in the midline and was enormously distended, to approximately six times its normal size. Once out of the abdomen it could not be replaced through the incision

due to its enormous distention. Its coat, as well as that of the greatly distended small intestine, was a dark red. In searching for the point of obstruction it was discovered that the cecum terminated suddenly to the right of the midline and that the transverse colon appeared to rise as mysteriously from the region of the hepatic flexure with no evidence of a connecting ascending colon. The descending colon and sigmoid were normal in size and position. The stomach and gall-bladder presented no pathology. The uterus, ovaries and tubes were definitely normal. These observations were made in a few moments. The actual cause or point of obstruction could not be located, but it seemed advisable to close the abdomen as quickly as possible at this time and relieve the distention by an emergency cecostomy, because of the exceedingly poor condition of the patient who went into shock on the table. Moreover, it did not seem to be good surgery to handle further the greatly distended gut for fear of traumatizing it. Further investigation could be carried on at a second operation should the patient recover.

A cecostomy was performed by bringing the appendix through a stab wound and amputating it. The abdomen was closed in layers. The patient rallied after a blood transfusion and continuous intravenous glucose. After the second day postoperatively she showed marked improvement. The colostomy functioned well. In fact the patient appeared to grow progressively better until the eleventh day, when temperature, pulse and respiration slowly mounted. Her general condition suddenly changed on the twelfth day, when she died at 10:25 P.M.

The pathologist found at autopsy that the cecum was in the midline, with a well walled-off cecostomy opening in the stab wound on the right side. The elongated, but now not distended cecum dipped down through the mesentery to the right of the midline and appeared to end there. The transverse colon appeared to spring from the region of the hepatic flexure, but showed no attachment at this point.

Careful dissection and freeing of the mesentery and areolar tissue coverings showed the ascending colon to be entirely retroperitoneal, lying at its beginning proximal to the vertebral column, assuming then an almost horizontal direction parallel to the transverse colon. In its distal third it took a tangential direction to the hepatic flexure. A fibrous band attached to the spinal column bound the gut at its proximal end, forming a complete obstruction. The gut immediately beyond this point had the shape of a half twist.

The apparent break in the continuity of the ascending and transverse colon previously noted at time of operation, was due to the fact that the ascending colon grew out of the peritoneal cavity. Both transverse and ascending colon were normal in position.

This defect may be explained most satisfactorily upon the basis of a defect in the prenatal course of torsion and mesenteric fusions. About the middle of the fourth month, all that portion of the mesentery which is attached to the segments of intestine destined later to become jejunum, ileum, ascending and transverse colon, is attached to the median line of the dorsal wall of the abdomen throughout its entire length. However, the original picture becomes greatly changed, because of fusions which occur in certain portions. The first of these is brought about by the twisting of the primary loop of the intestine. As a result the ascending and descending colons are brought close to the lateral walls of the abdominal cavity. The parietal peritoneum lining the right abdominal wall becomes fused to the right layer of the mesentery attached to the ascending colon. A similar fusion takes place in the left. Thus the ascending and descending colons lose their mesenteries and have a permanently fixed position.

The transverse colon passes ventral to the duodenum. Its mesocolon never comes in contact with the parietal peritoneum, and its line of attachment is transverse to the body wall. This line of attachment forces the duodenum against the dorsal abdominal wall, because of its passage in front of the gut, thus making this part of the gut retroperitoneal. What was the dorsal mesentery disappears and changes into subserous areolar tissue.

The cecum and appendix are primarily a lateral outpouching of the intestines, are

completely encased by peritoneum and do not possess any mesentery.

With the foregoing embryologic facts in mind, two possible theories may be advanced to explain the retroperitoneal ascending colon: (1) Since the transverse mesocolon, through its transverse line of attachment passing across the duodenum, presses this organ against the dorsal abdominal wall causing it to lose its mesentery and become retroperitoneal, can it not be assumed that this same mesocolon could have pressed, in an error of torsion and fusion against the ascending colon (which in this instance lay part way parallel to the duodenum), converting its mesentery into subserous areolar tissue and causing it to be retroperitoneal. (2) It is possible that the ascending portion of the primary gut in its torsion did not stop at a 90 degree angle of the normal colon, but continued torsion until it lay in a nearly transverse direction behind the root of the mesocolon.

At best these are theories, but they give some explanation of the anomaly described.

SUMMARY

1. The purpose of this paper is to report an unusual anomaly of the ascending colon in an adult female who showed no other congenital defects. Anomalies of the gastrointestinal tract are usually found in male children who show other defects.

2. The ascending colon was not in the peritoneal cavity. For this reason the point of obstruction which was in the ascending colon was not found at operation, but later at autopsy.

3. Its retroperitoneal position can probably be explained upon the basis of a defect in the torsion of the primary gut, or defect in the fusion of its mesentery.

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FASCIA LATA TRANSPLANT FOR PTOSIS*

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IT is not the purpose of this paper to encompass an involved discussion on the various operative procedures which have been and are being used for the correction of ptosis, but merely to set forth a method I have found satisfactory. The methods any particular surgeon utilizes in carrying out operative procedures depend primarily on his training and the type of surgery he does. Thus, an ophthalmologist will prefer one of the various eye muscle procedures, while the general reconstructive surgeon will probably select a method akin to the one here described. In either case, results form the criteria by which the operation can be judged.

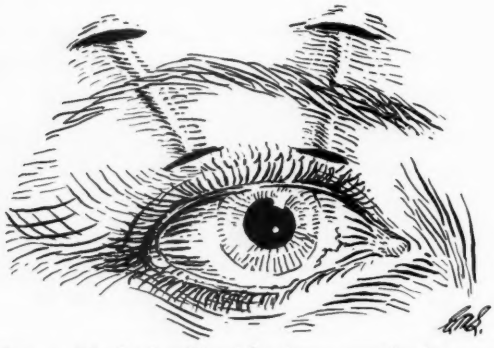

FIG. 1. Method utilized by Lexer employing two strips of fascia.

Most of the ptosis cases requiring surgical interference are congenital and usually bilateral. The muscular apparatus of the eye is generally otherwise normal, and this fact forms the basis for the utilization of the superior rectus in various operations described by ophthalmologists. Syphilis and previous encephalitis must also be considered as etiologic factors.

In 1879, Dransart devised the plan of uniting the tarsus to the occipitofrontalis by three double silk sutures which, when withdrawn, left trails of subcutaneous scar, thus fixing the tarsus to the frontalis.[1] It was desirable in this procedure to allow a certain amount of irritation and perhaps suppuration to promote additional scarring. The obvious weakness of this procedure is that scar is not a very dependable connecting tissue.

Pagenstecher and Hess also utilized threads to connect the tarsus to the occipitofrontalis. Panas modified this procedure by utilizing a pedicled skin flap to connect these two structures.

Lexer, in 1923, employed two strips of fascia (Fig. 1) to make the connection between the tarsus and frontalis. This was a distinct advance in that living tissue was utilized. The fascia lata to a great extent remains unchanged, except for some contraction which emphasizes the lifting result desired.[2]

Derby proposed the use of fascia lata in the form of a sling in 1928 and reported good results.[3]

Blair, Brown, and Hamm have utilized a fascia lata sling from the occipitofrontalis to the upper edge of the tarsus. They recommend the use of two small incisions in the lid through which the fascia is threaded.[4] (Fig. 2.)

The operation, which I have used in the three cases which are presented in this discussion, combines the advantage of the fascia lata sling with resection of a portion of the lid. It is interesting to note at this point that one patient in this series actually suggested some form of suspension from the forehead, inasmuch as he had for years utilized a strip of adhesive running from the forehead to the ptosed eyelid. Nature points the way to some such procedure by overdevelopment of the occipitofrontalis due to a constant attempt to use this muscle in lifting the ptosed lid. This

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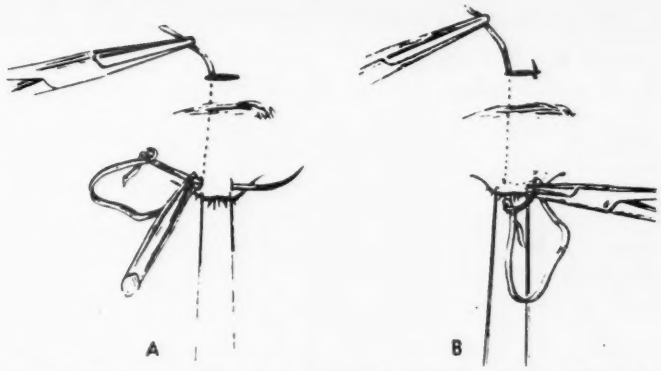


Fig. 2. Blair's method of threading fascia lata. (From Blair, in *Arch. Ophth.*, 7: 831, 1932.)

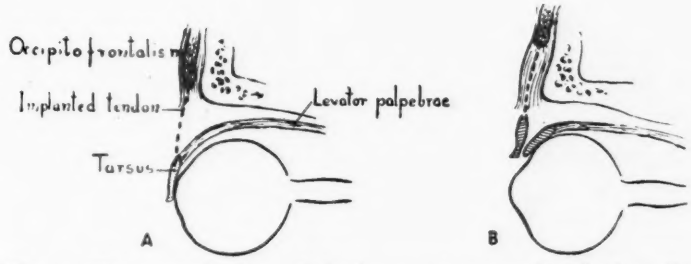


Fig. 3. The normal action of the levator contrasted with that of the transplanted fascia. (From Blair, in *Arch. Ophth.*, 7: 831, 1932.)

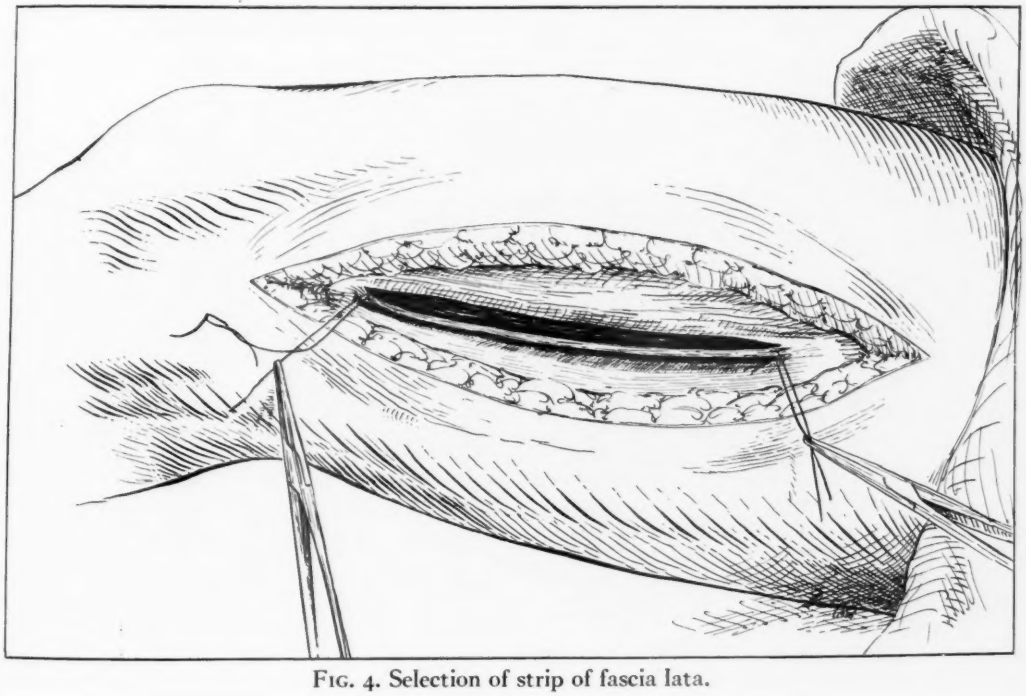


Fig. 4. Selection of strip of fascia lata.

hypertrophy is probably more marked where there is slight residual lifting power in the levator palpebrae superioris.

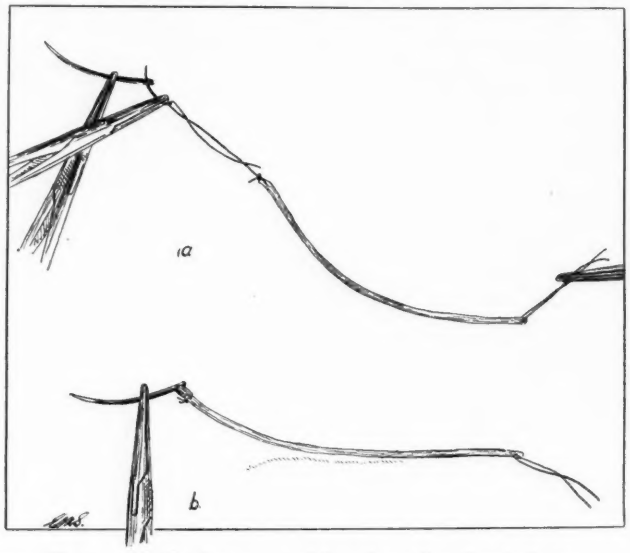


Fig. 5. Method suggested for threading fascia lata.

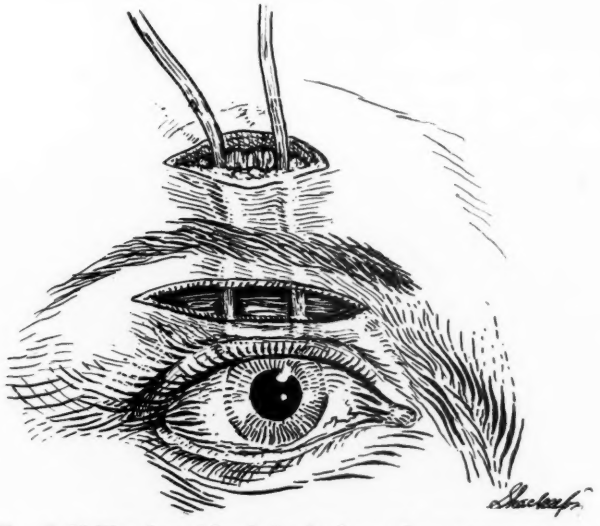


Fig. 6. Utilization of fascia in the form of a mattress suture.

In my experience this combined procedure has been successful both as to function and cosmetic result. Psychologically these people lose their shyness and backwardness. They also lose the constant strained expression when attempting to open their eyes, and most strikingly they lose the necessity for throwing the head backwards in order to be able to see.

Few operations which are reconstructive in scope can claim perfection in imitating nature's own efforts. Blair has pointed out one functional disadvantage to this procedure. He has shown that the normal functioning levator pulls the tarsus around the circumference of the globe. However, the pull of the occipitofrontalis is directly upwards throughout its entire excursion. (Fig. 3.) This difficulty is more theoretical than real since the ordinary onlooker does not notice any difference.

PREOPERATIVE CARE

Preoperative preparation consists of thorough shaving of the eyebrow on the side to be operated. The thigh on the same side is shaved and washed with ether, soap,

water, and alcohol the night before. It is then wrapped in sterile towels.

The patient is given 1½ gr. of nembutal one hour before and 1½ gr. one-half hour before operation. If the patient is not narcotized at the time of operation morphine sulfate gr. ⅙ is given.

In the operating room, the entire face is thoroughly washed with soap and water for five minutes, and then with 70 per cent alcohol. After thorough drying the operative field is painted and the patient is draped.

The subcutaneous tissues of the upper lid and corresponding supraorbital region are thoroughly infiltrated with 2 per cent novocaine. Attention is then directed to the thigh. After novocaine infiltration an incision is made on the anterolateral surface of the thigh and deepened down to the fascia. The tissue over the fascia is gently cleaned off and a strip of fascia about 15 to 16 cm. long and 3 mm. wide is selected. It is marked out (in the manner suggested by Blair): the longitudinal strands are separated by the back of a bistoury blade and the transverse fibers incised with a No. 15 Bard-Parker blade. The strip is left attached at both ends and a piece of .004 DeKnatel silk is passed through each end with a No. 2 Sheehan needle. (Fig. 4.) The needle is left attached at one end and the strip disconnected.

A half-curve surgical needle, long enough to reach from above the eyebrow to the tarsus is selected and the fascia threaded on to it by passing the Sheehan needle through

A B

Fig. 7. Case 1. A, before operation. B, after operation on left eye.

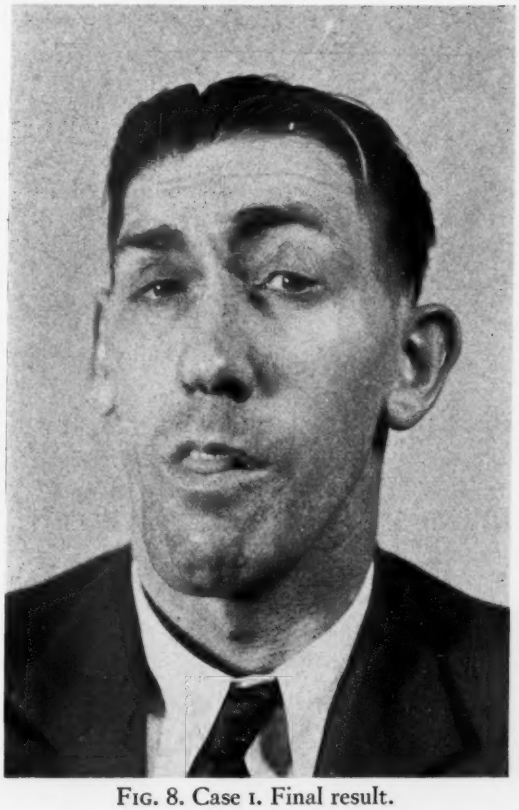
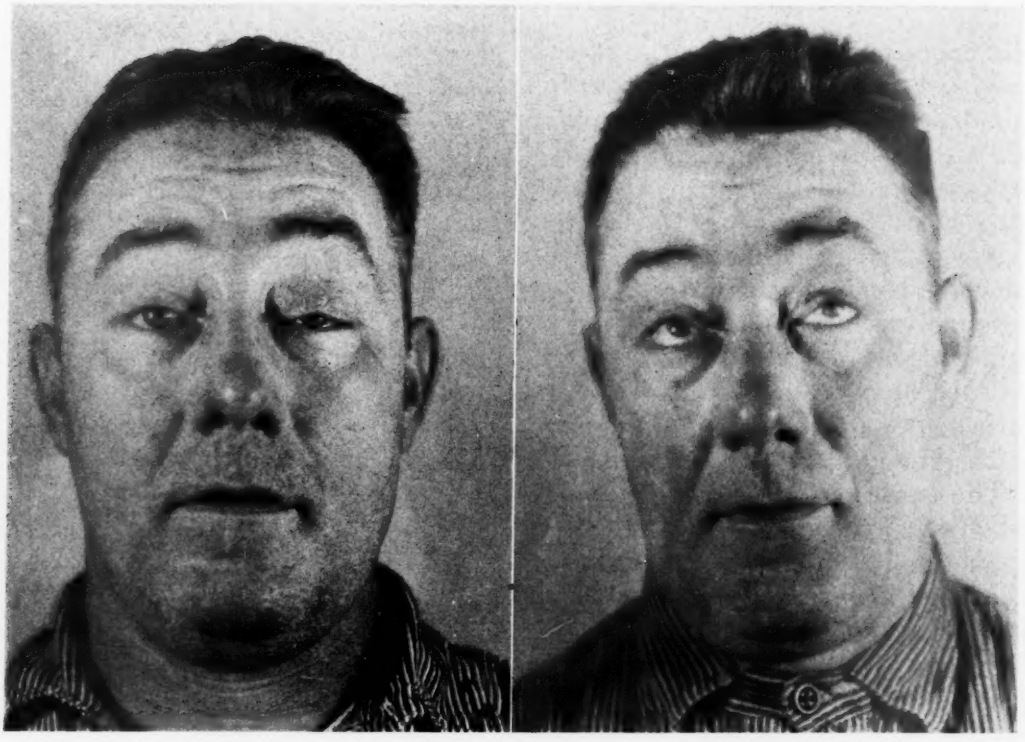


Fig. 8. Case 1. Final result.

A B

FIG. 9. Case II. A, At rest, before operation. B, at rest, after operation.



A B

FIG. 10. Case II. A, before operation, showing maximum lift. B, after operation, showing maximum lift.

the eye of the larger needle and pulling the fascial strip through. The fascia is then fixed upon itself with the same silk suture.

A B

Fig. 11. Case III. A, before operation. B, after operation.

(Fig. 5.) The fascial strip is then replaced in the depths of the thigh incision and covered with a pack moistened with saline.

Attention is again directed to the eye. Two fine silk sutures are placed at the lid margin to act as tractors. An oblong portion of lid and orbicularis oculi is excised with a No. 15 Bard-Parker blade. This portion is usually about ¼ inch at its widest portion and tapers toward each end. A transverse incision ½ inch in length is made immediately above the eyebrow and corresponding to the mid-portion of the lid incision. The incision is deepened down to the occipitofrontalis muscle. The subcutaneous tissues are freed down to the eyelid with a dissecting scissors.

The fascia lata is secured and passed as a mattress suture beginning at the medial end of the forehead incision, passing through the muscle and over the supraorbital ridge subcutaneously, to emerge at the medial border of the lid incision. It engages the superior border of the tarsus transversely. A wide enough area must be engaged so that the lid does not become angulated at the point of attachment. The assistant lifts the lid at this point by pulling on the traction sutures so that the suture is not passed through the conjunctival surface of the lid. The needle is passed upward subcutaneously and then through the occipitofrontalis lateral to the point where the suture first entered the muscle. (Fig. 6.) Here it is tied in one knot and pulled taut until the lid is raised to the point where only about ⅙ of the pupil is covered. At this point the traction sutures are removed. A mosquito forceps is clamped at the knot while interrupted sutures of fine silk are taken to secure it to the occipitofrontalis muscle and also to keep the knot firmly tied. The redundant fascia is excised and both skin incisions are closed with interrupted .0025 silk. A cotton pad is used on both eyes for twenty-four hours.

The fascia lata is closed with a continuous suture of No. 0 chromic and the skin closed with interrupted dermal.

It has been my experience that the conjunctival surface which has not been exposed to the outside for many years may show evidence of irritation twenty-four to forty-eight hours later. If so, simple boric acid eye irrigations and argyrol instillations are of value.

The facial sutures are removed in three days and at this time the patient may start to lift his lid voluntarily. Edema is present for forty-eight to seventy-two hours, but this rapidly subsides. At the end of three weeks additional contraction has usually raised the lid a few more millimeters. The skin incisions are barely visible after complete healing has taken place.

CASE RECORDS

Case I. A. H., laborer, had always had great difficulty in raising his lids. The droop was more marked on the left side, but he was unable to see from either eye without throwing back his head. There was no personal or family history of syphilis. Blood Wassermann was negative.

Physical examination showed bilateral ptosis, more marked on the left. There was definite weakness of the superior rectus on both sides. On the right side the lid could clear half the pupil with effort. On the left side there was barely any lift.

On September 9, 1936 the left lid was operated on. Following operation there was marked conjunctivitis and photophobia. On February 23, 1937 the procedure was repeated on the right side. All wounds healed by primary intention. (Figs. 7 and 8.)

Case II. J. O'L., age 44, printer, was committed to Mayview City Hospital eleven years previous to operation for repeated attacks of unconsciousness diagnosed as grand mal epilepsy. The patient had poliomyelitis at 3 years of age and dated his ptosis from that time. There was no familial history of insanity, epilepsy, or ptosis.

Physical examination showed a ptosis of the left lid with atrophy of the levator palpebrae superioris. Other eye muscles were normal. Both pupils reacted well to light and accommodation. Blood Wassermann was negative.

Neurologic examination showed an absent knee jerk on the right and atrophy of the left leg muscles. On December 11, 1936 operation was performed on the left lid. All wounds healed by primary intention. Six months later patient was able to lift lid well and the cosmetic result was very satisfactory. (Figs. 9 and 10.)

Case III. W. C., age 20, a machinist, stated that ever since birth he had been unable to raise his lids. His field of vision was always just about one-half of what it was when he would raise both lids with his fingers. In order to see straight ahead he was forced to throw his head backward. This inability to see properly made him self-conscious and shy and definitely interfered with the proper pursuit of his occupation. There was no history of any similar complaint in his family.

Physical examination showed bilateral atrophy of the levator palpebrae superioris muscles with an inability to raise either lid. Both pupils were partly covered by the lids. Reaction to light and accommodation was normal.

On August 10, 1936 the right lid was repaired and on September 28, 1936 the procedure was repeated on the other side. The resultant functional and cosmetic results were good on both sides. All wounds healed by primary intention. (Fig. 11.)

CONCLUSIONS

This operation is not perfection, but the functional result is excellent and the cosmetic result good. Certain disadvantages have been pointed out, but they are more theoretical than real.

Patients with ptosis should be given the benefit of some satisfactory procedure since the entire psychological make-up is favorably influenced by a good result.

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ECTOPIA AND INGUINAL HERNIA OF OVARY

REPORT OF A CASE OF CONGENITAL ECTOPIA OF OVARY AND FALLOPIAN TUBE IN LABIUM MAJUS

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THE patient here reported was a white female, age 26, married, primipara of healthy and medium constitution, without familial or personal antecedents of note.

At the age of 7 years, she noticed a small tumefaction in the left inguinal region; its size was that of a small marble and it continued to grow with body development. Menstruation began at the age of 14 years. It was regular and free of pain for two months. External reduction of the tumor was attempted after the second menstruation, and for five months the mass could not be detected. During this period, there was cessation of menstruation. When the tumor reappeared, it occupied a lower position in the inguinal region, reaching to the labium majus. Shortly after the tumor reappeared the menstrual flow returned, and has since been regular, of four weeks' interval and four to five days' duration. Instead of a painless menstruation, as that of the first two periods, the patient had pain in the left inguinal region and labium majus, the pain coming on two or three days prior to the appearance of the menstruation and with an increase in the size of tumor. Such a periodic cycle and increase in size of tumor continued until she came to surgery.

Five years before I saw the patient, a truss was applied and worn for two months. Wearing the truss produced much pain with no change in the size and position of the tumor.

The physical and laboratory findings were essentially normal except for a swelling in the left lower inguinal region and labium majus. The main axis of the tumor was oblique downward, extending well into the upper fold of labium majus. It was the size of a mandarin. The skin region was sound and gliding over the tumefaction. The mass was not painful to palpation, had a clear outline of hard elastic consistency, with an area of hardening at the lower pole, but for the main, the tumor was smooth and firm.

Vaginal examination was normal except for a moderate retroversion of the uterus and a tilt of the uterus to the left pelvis. The right adnexa was palpable and in close proximity to the uterus. The left adnexa, due to the lateral position of the uterus to the left inguinal fold, could not be outlined. Attempt to replace the uterus from the left inguinal region position produced radiating pain along the canal of Nuck to the mass in the labium majus.

The diagnosis made was tumor of the left inguinal region and labium majus, probably an ovarian hernia with incarceration.

Operation was performed on August 9, 1937. A preliminary injection of morphine and scopolamine was given, followed by local anesthesia of novocaine and ephedrine. The skin incision was made from the labium majus upward in an oblique manner over the canal of Nuck, for a sufficient distance to assure good exposure. The incision was carried through the skin and superficial fascia. A large globular mass, enclosed within a sac, was found. It was hard in consistency and fairly regular in outline, except for the lower pole and many old adhesions about the sac and the integument. The hernia sac was covered in part by strands of muscle tissue running along the outer lateral surface.

The sac was incised and its content was found to be ovary, fallopian tube, mesovarium and round ligament. The ovarian mass was adherent and fixed to the base of sac along the external and lower portion. The ovary was enlarged and there was a hypertrophy of all structures except the fimbriated end of the fallopian tube. The tumor mass was rotated 180 degrees on its attached pedicle. The tumor appeared dark, apoplectic in color. Also there was hypertrophy of the structures of the pedicle, including the genito-inguinal ligament. The hypertrophy of the pedicle was so great that is was impossible to pass a probe along the canal of Nuck to the internal peritoneal ring. There appeared a definite fibrous sac encircling the mass, extending from the base of ovary upward along the pedicle. This was enclosed in the common

vagina. The canal of Nuck was opened and explored to and above the external peritoneal ring, with excision of the peduncle and removal of the hernia mass. Care was exercised in the excision of the pedicle to avoid hemorrhage. Its structures were separated from the genito-inguinal or round ligament and ligated. The raw surface of the stem of the pedicle was covered over by infolding the loose accompanying areolar tissue. The stem was permitted to drop into the peritoneal cavity. The round ligament was found to be very short, and to release the uterus from the left inguinal canal, we deemed it necessary to excise the genito-inguinal ligament. Its stump was later anchored to the fibrous portion of the abdominus muscle at a point to release the traction on the uterus. Hernioplasty was done by a modified Bassini type of operation. The sutures were placed in an interrupted manner for the shelving layers. The skin was closed with interrupted dermal sutures. The convalescence was normal. The patient remained in bed two weeks.

Fig. 1. Enveloping membrane at base (tunica vaginalis). Gubernaculum (or round ligament) attached to inner wall of tunica and ovary with oviduct at upper margin with hypertrophy of round ligament.

Fig. 2. Cut section, showing opened corpus luteum at upper pole. Several old hemorrhagic follicles are visible and an occasional enlarged follicle.

Pathologic Examination. Specimen consisted of an ovary 8.5 by 2.5 by 2 cm. Attached to one side of the ovary was a thick meso-ovarium (5.5 cm.) of triangular shape with its base against the ovary. One side of the triangular mass served as an attachment for the oviduct which was 6 cm. long and .9 cm. in greatest diameter. This was free of gross changes. On the opposite side of the triangular mass there arose from the pole of the ovary a rounded, cord-like structure 2 cm. long and .9 cm. in diameter. This, on section, showed a central group of tubular structure, obviously blood vessels. The basal or ovarian end of the cord was continuous with an enveloping pouch of fibromuscular tissue, which was lined by serous membrane similar to that continuous with the surface of the ovary. At the distal end of the triangular mass above mentioned, the oviduct and round ligament approximated each other. At this end the meso-ovarium, round ligament and oviduct had been cut across in the removal of the mass.

On section, the ovary contained at its tubal end a recently formed corpus luteum 2 by 1 cm. Through the remainder of the ovary there were three old cysts 1 by 6 by 7 mm. in diameter, filled with old brown, bloody coagulum. The ovarian capsule was thick and tough and there were a few enlarged follicles near the capsular surface.

Sections showed a dense fibrous capsule and a fibromuscular stroma richly supplied by blood vessels. The veins were dilated and engorged.

A number of enlarged follicles were present and some contained ova and a clear serous fluid. One large follicular cyst was filled with old blood clot. About the margins there was a loose clear connective tissue, in which were entrapped granules of blood pigment. There were also occasional small corpora albicantia which showed similar deposits of the pigment. None of the sections showed lutein cell formation.

COMMENT

Hernia of the ovary is rare, and 95 per cent of ovarian hernias are inguinal. The persistence of the canal of Nuck bears the greatest significance in the causation of inguinal hernia. Normally the canal of Nuck becomes obliterated by the end of the eighth month of intra-uterine life. In a small percentage of cases the canal of Nuck does not become obliterated but remains in part or completely pervious throughout life.

The gubernaculum of the ovary, which is the anlage of the ovarian and round ligament, becomes attached to the cornua of the uterus. This prevents the descent of the ovary into the inguinal canal in normal development, even though the distal end of the gubernaculum is attached to the labium majus.

All writers, in discussing the cause of the descent of the ovary into the inguinal canal (or labium majus), agree that it is a congenital anomaly. The following explanation more nearly approaches the physiology of ovarian hernias: (1) The genital deformity is an indication of absence or deficiency of a given stimulus, perhaps hormonic, to the development of the genital system, which is inclining toward the feminine; it would be in such a case a deviation of development to the male type, which would bring the abnormal descent of the ovary. (2) The failure of the genito-inguinal ligament to adhere to the deformed or undeveloped uterus and the presence of the open canal of Nuck pull the ovary by the gubernaculum into the labium majus.

Before Hunter's ligament or the gubernaculum becomes adherent to the uterus, there is no substantial difference in the morphology of the two sexes, which may explain the failure of the ovary to descend. Deformity of genital development is undeniable; instances of combined gland or ovotestis (hermaphroditism) have occasionally been found in this type of hernia.

The hereditary influence on hernia is to be considered. Berger's report,[1] from an analysis of several thousand cases of hernia, reveals that more than one-third of the cases could be associated with heredity. Among the physiopathologic causes of hernia pregnancy stands first. Heinick[2] shows 79.9 per cent of the patients had borne children.

Inguinal ectopia of the ovary presents certain characteristics which are not found in simple ovarian hernia. In true ectopia the tube usually accompanies the ovary, which is explained by the intimate relationship between the genital gland and the upper part of Müller's duct. The cord is shorter and is tapered due to constriction, and like the testicle is classed as an extraperitoneal organ, covered by a fold of the canal of Nuck. The peritoneal diverticulum is always present in these cases, partially obliterated or completely pervious. In both the ectopic ovary and simple hernia of the ovary, the ovary may undergo all possible alterations, inflammatory, degenerative or neoplastic. In the author's case the ovary was enlarged, the capsule was thickened and the ovary contained many retention cysts.

Ovarian hernia occurs most frequently in infants and children. Surgical measures should be instituted without delay, providing the nutritional index of the child will permit operation. The condition requires early recognition since, to save the ovary, surgical measures should be instituted before the circulation becomes altered and other catastrophes develop to necessitate removal. Wakeley[3] reported three infants (2, 6 and 7 months of age) who came to operation with good results; in each case the ovary and tube were replaced in the abdomen and permitted to develop normally.

CONCLUSIONS

1. Ovarian hernias are congenital. In children with ovarian hernia the ovary will appear at the inguinal region or labium majus as a small hard rounded swelling, movable and usually not tender unless there are circulatory changes in the herniated parts.

2. After puberty when a patient offers a history of the presence of a lump in the groin, whether stationary or not, and increase in the size and discomfort of the inguinal or labium majus mass at menstruation, hernia of the ovary should be carefully considered.

3. Surgery promptly instituted and carried out along the proper principles will save many ovaries. Delay and palliative measures may cause strangulation or pathologic changes.

4. It is obvious that ovulation in the ectopic ovary is useless for the purpose of reproduction and if the ectopia is bilateral, there is sterility. In simple hernia, even though bilateral, pregnancy can occur.

5. The Bassini type of operation offers the best results for the repair of hernia in the female. Local anesthesia, novocaine and ephedrine, is ideal for all cases except the infant and very young.

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SARCOMA OF THE OVARY

CASE REPORT

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Y. S., single, Japanese, aged 24, a housemaid, was seen January 25, 1937 because of a large firm rounded mass in the lower abdomen arising out of the pelvis.

She had been well all her life except for minor childhood illnesses, until at the age of 23 she noticed a mild non-radiating pain in her right lower abdomen. It came on insidiously and disappeared spontaneously after two days, although she continued with her housework. No lump was noted at that time and she did not consult a physician. Six months later a similar transient dull pain recurred. This time she felt a small hard lump low in the right side of the abdomen. Nine months thereafter this pain reappeared and she consulted her family physician for the first time. He ordered local application of heat and some oral medication for the relief of the pain. She was pain-free in four or five days. The mass was definitely larger at this time and the slow, progressive enlargement continued unabated. There were no more attacks of pain and she kept on with her work as housemaid, performing the usual tasks with but little discomfort. At no time was there any evidence of associated gastrointestinal, cardiorespiratory, or genitourinary distress.

The menses began at 14 and were entirely normal, with slight pain during the first twenty-four hours of the flow. The last period was fourteen days before examination, a normal five day flow. She denied coitus. The past and family histories were flatly negative.

The patient was a frail, slender, shy Japanese girl, in no apparent discomfort. Temperature was 99, pulse 92, respirations 20. The chest was thin, flat, and poorly muscled, the breasts small and undeveloped. Blood pressure was 124/76. The lower abdomen was asymmetrically enlarged, mostly to the right of the midline where a tumor, firm and hard, the size of a five month's pregnancy was felt. The right margin of the mass was round, the left borders smooth, though some indentation could be felt. The upper edge of the tumor extended to the umbilicus while its lower limits extended deep into the right pelvis. No pulsation, bruit, funic souffle, fetal heart sounds, nor movements could be heard. On transillumination from the side of the tumor there was no indication of translucency. The upper pole of the tumor could be pushed about at will, but its lower pole was firmly fixed. No fluid wave was elicited and no other abnormal abdominal findings were noted.

On pelvic examination the introitus was very narrow, barely admitting one finger; the hymen was intact. The cervix was normal in appearance and consistency. The uterus was small, firm and in normal position. No abnormality was present in the left adnexal region, but the entire right fornix was occupied by a hard unyielding tumor anchored in the right adnexal pedicle and pushing the uterus slightly to the left of the midline. Only moderate tenderness was present and this only upon firm pressure upward in the right fornix by the examining hand. The tumor was not ballotable and there was no cystic feel to it. Rectal examination merely confirmed the findings on vaginal examination. Other physical findings were negative.

A flat *x*-ray plate of the pelvis showed no evidence of the calcific deposits of a teratoma. The blood count was normal except for a slight leucopenia. The urine, blood Wassermann and Kahn tests were negative.

A preoperative diagnosis of right ovarian cyst was made. This hypothesis was based on the following evidence:

1. Presence of a clearly palpable uterus entirely normal as to location, consistency, shape and size.

2. Presence of a large, firm, rounded tumor mass palpable distinctly to the right of the uterus, and rising up and out of the pelvic cavity.

3. Absence of clinical and roentgenologic signs of intra- or extra-uterine pregnancy.

4. Absence of symptoms or signs suggesting a process arising from the right kidney or intestinal tract. Due to the firmness of the

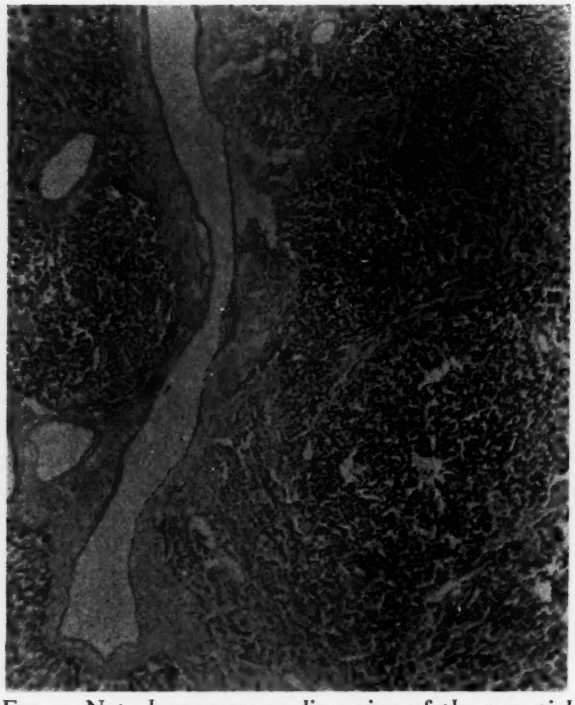

FIG. 1. Note homogeneous dispersion of the essential tumor cells and thin walled vascular spaces.

tumor, and its opacity on attempts at transillumination, it was thought that the tumor might be a solid or cystic teratoma, or an ovarian fibroma. A pedunculated myoma with a long stalk was also considered as a possibility.

Under cyclopropane anesthesia the abdomen was opened through a midline incision which was prolonged upward for an inch above and just to the left of the umbilicus. No free fluid was encountered in the peritoneal cavity. A hard, glistening white smooth oval tumor involving and apparently replacing the right ovary was encountered. It was non-adherent, and no raw surfaces were seen. The right tube was virtually obliterated by the tumor, which was pedunculated and was pushing a normal uterus to the left of the midline. The tumor was found to be twisted on its pedicle for three-fourths of a turn in a clockwise manner. It was untwisted, and the pedicle was severed and ligated. The raw surface was peritonealized and simple appendectomy was done. The uterus and left adnexa appeared normal, and were unmolested. The wound was closed in layers without drainage.

Convalescence was uneventful and the patient left the hospital on the fifteenth postoperative day in excellent general condition with primary union of the incision.

An *x*-ray photograph of the lungs taken on the eighteenth postoperative day showed no evidence of metastasis, and an Aschheim-Zondek test four months after operation was negative. More than a year postoperatively there had been no evidence of recurrence of the tumor.

The neoplasm weighed 2½ pounds immediately after removal and measured 14.2 by 12 by 9.5 cm. Its structure was peculiar. The capsule was very thin but entire throughout, except at the pedicle. The cut surface was quite homogeneous, and of a faint pinkish-white; it resembled the cut surface of testicle rather than ovary. Grossly, faint lobulations appeared, but fibrous trabeculae and stroma were almost altogether absent. Only very thick frozen sections were possible because of the high cellularity and this absence of stroma.

Microscopically, the stroma also was scarce, blood vessels and vascular sinuses were prominent (many of the latter formed only by a layer of endothelium). In the few areas of necrosis and in the scant connective tissue, lymphocytes appeared. The essential cell was a large, round, juicy one of very embryonal character. In some areas there was no order to the arrangement of these cells, in others, they were arranged in straight and twisted cords, the parallel ones sometimes simulating tubules. The essential cell had a rather scant cytoplasm but a very large nucleus, though not overly rich in chromatin. Atypical mitoses were very numerous, reflecting the rapid growth of the tumor.

We believed it to be a large round-cell sarcoma of the ovary, probably primary in the mesodermic portion of a solid teratoma. This last is speculative for it is obvious that serial sections on a 2½ pound tumor, in search of ectoderm and entoderm, are out of the question, but there is evidence that the representative cells of one of the blastomere layers in teratoma may proliferate at the expense of the other blastomere representatives till these latter are partially or wholly obliterated, probably from pressure atrophy. Frank[5] has pointed to the excessive proliferative capacity of the embryonal mesoderm and the fact that when a solid teratoma metastasizes, the metastases are

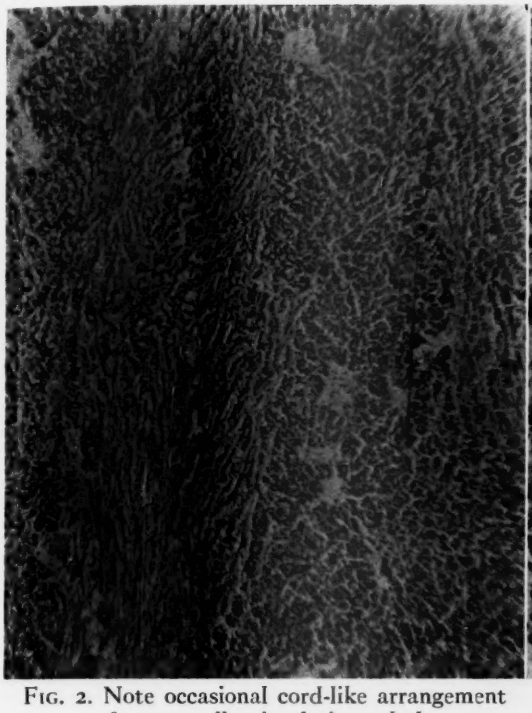

Fig. 2. Note occasional cord-like arrangement of tumor cells, simulating tubules.

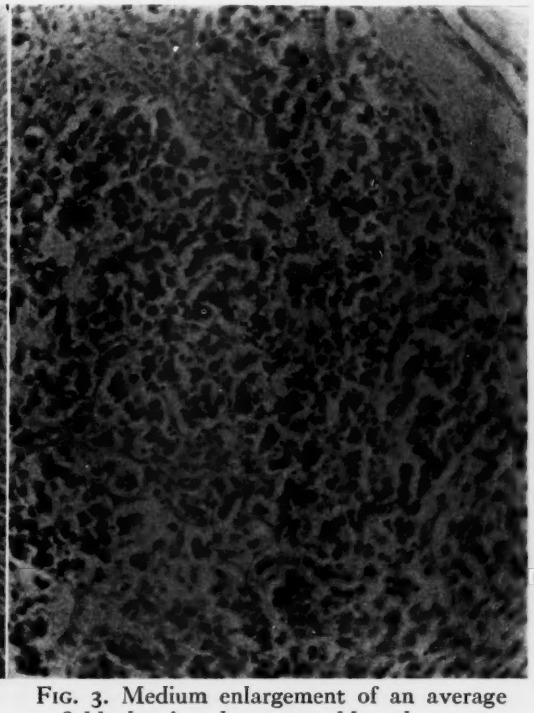

Fig. 3. Medium enlargement of an average field, showing the scattered lymphocytes.

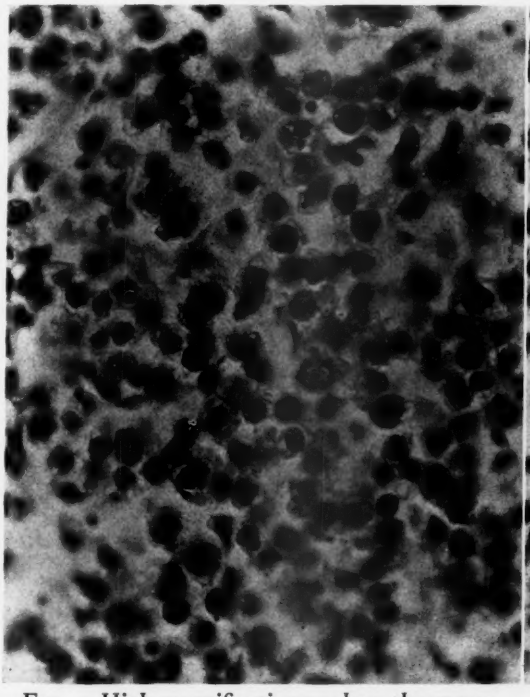

Fig. 4. High magnification to show the sparse cytoplasm, the empty intercellular spaces and varying quantity and quality of the nuclear chromatin. Mitoses are numerous.

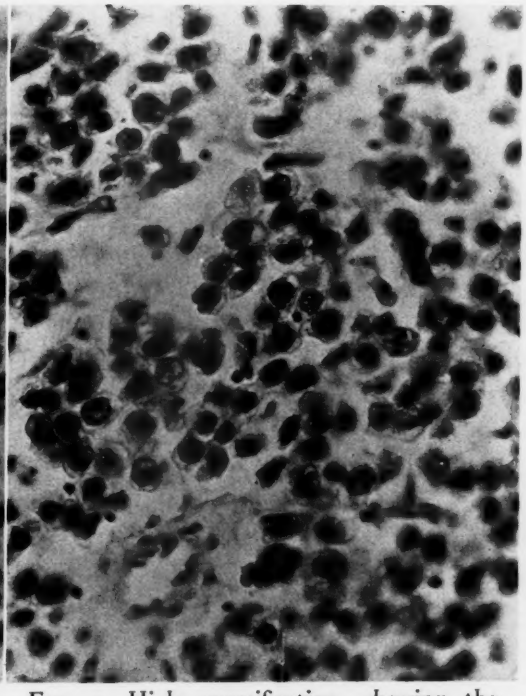

Fig. 5. High magnification, showing the character of the intrinsic cells, an arteriole and several mitoses.

composed mainly of mesoderm. This tumor seems to fit properly into the group of ovarian tumors known as *dysgerminomas* or indifferent cell tumors.[8]

COMMENT

An unusual type of ovarian tumor is presented. The patient was alive and well with no evidence of recurrence more than a year after unilateral oöphorectomy with removal of the tumorous ovary only. The hypothesis is advanced that the malignancy probably arose from a solid teratoma of the right ovary, though Gardner[7] points out that such malignant tumors are usually mixed. The subject of sarcomata of the ovary in general has been well covered by other writers including Scheffey,[12] Bland-Sutton,[3] and Kaufmann,[10] and is therefore not here dwelt upon. Careful examination of our patient at operation showed no ascites. This does not bear out Graves'[9] statement that ascites is present with all solid tumors of the ovary, nor that of Boyd[4] who states that ascites is invariably present with sarcoma of the ovary.

Opinion is divided as to whether one or both ovaries should be removed in this type of case. Anspach[1] takes the radical view in his textbook, although unilateral oöphorectomy only was done in his case reported by Scheffey.[12] Björkheim[2] has reported a case of malignant tumor of mesenchymal origin in a girl of 6 in whom unilateral oöphorectomy was done. That patient was well and attending school two years later.

It would seem advisable to have an immediate frozen section done on any solid tumor of the ovary, and to remove both ovaries should there be any suspicion of malignancy in the contralateral ovary. In any case of doubt, the Aschheim-Zondek test should be of value in ruling out recurrence of sarcoma arising from teratomas. A roentgenogram of the chest should be taken in every case of proved or suspected ovarian malignancy, preferably before operation.

Although a year's observation is too short to rule out any possibility of recurrence, the case is reported because of its unique features and the likelihood that we have a true cure. Conservatism with regard to the contralateral ovary may occasionally be justified in a case in which the ovarian sarcoma has a clearly defined capsule, is free from adhesions, if there is no fluid in the peritoneal cavity and if the ovary of the opposite side appears grossly entirely normal.

SUMMARY

A case of unusual ovarian tumor in a nullipara of 24 is presented. It is believed the tumor is a sarcoma, primary in a solid teratoma; it was very cellular and had very little stroma. Unilateral salpingo-oöphorectomy only was done without recurrence or metastases after eighteen months.

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MUCOUS ADENOCARCINOMA OF THE BLADDER*

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PRIMARY mucin containing adenocarcinoma or colloid carcinoma of the bladder is a rarity. This case is reported as one quite typically characteristic of this infrequent grouping.

R. S., a white male, age 41, was admitted to the Jersey City Medical Center, January 23, 1936, complaining of intermittent hematuria for one month. This had started as a terminal bleeding of a few drops, with only occasional slight burning at the end of micturition. Apart from this, the patient was quite comfortable, experiencing no dysuria, urgency, difficulty, frequency or other untoward symptom. He daily pursued his occupation as mechanical engineer, without restriction. Gradually, the bleeding increased from a few terminal drops to a complete hematuria, with clots, mucus shreds and occasional finely granular calcareous material.

On admission to the hospital his red count was 4,470,000; 70 per cent hemoglobin (Tallquist); white count 5,350 with 66 per cent polymorphonuclear neutrophiles, 34 per cent lymphocytes. The Wassermann was negative. P.S.P. test: first specimen 52 per cent; second specimen 27 per cent. Non-protein nitrogen was 25 mg., sugar 104 mg. per cent. Other clinical laboratory findings and physical examinations were negative, as was the flat *x*-ray of the abdomen.

Cystoscopy revealed a small tumor at the apex of the vault of the bladder about 0.5 cm. in largest diameter, papillomatous and pedunculated, floating freely in the distended bladder. Its surface was irregular and appeared ulcerated and bleeding at one point. The remainder of the bladder mucosa appeared normal. A biopsy was taken and the tumor fulgurated. The patient was discharged the day following admission.

The biopsy at this time showed fragments of tissue composed of delicate villi lined with several layers of rather uniform transitional cells with conspicuous nuclei devoid of any demonstrable mitosis. The stroma was edematous, vascular and diffusely infiltrated with polymorphonuclear neutrophiles. The biopsy was considered inadequate to render a definite diagnosis. The possibility of papilloma was suggested.

Subsequent Course. The patient recovered, had no unusual urinary symptoms, voiding five to six times a day and only occasionally at night. Gross bleeding had ceased, but microscopic examination of the urine revealed usually some red cells and a considerable number of polymorphonuclear neutrophiles. About ten weeks after discharge from the hospital, a cystoscopic check-up was done. At this time, the tumor was again observed at the vault of the bladder. The neoplasm appeared definitely larger than on previous examination, measuring now approximately 2.5 cm. in diameter; it no longer appeared pedunculated, but infiltrating and ulcerated in its center which was irregular, covered with slough and calcareous deposits. The remainder of the bladder appeared inflamed and hyperemic. Resection of the tumor was advised.

The patient was readmitted to the hospital April 30 (three months after the first admission). On April 21, 1936, under spinal anesthesia a suprapubic cystotomy was done. The tumor mass was readily palpable through the vault of the bladder; the peritoneum stripped easily and the bladder mobilized. The peritoneum was opened accidentally, which permitted exploration of the abdominal cavity; no evidence of tumor was found therein. The peritoneum was then closed. The bladder was opened apart from the tumor site. A proliferating, soft, cauliflower-like growth about 2.5 by 2.5 cm. was presented on the anterior superior portion of the vault just slightly to the right of the midline. Whereas the surface appeared soft and necrotic, it definitely involved a greater portion of the thickness of the bladder wall. A smaller, firm nodular growth 0.5 cm. in diam-

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eter was found about 1 cm. posterior to the larger tumor. With the electrocautery knife, the involved areas was removed; the resection included a margin of 1 cm. of healthy bladder wall around the growth. The bladder was closed around a Pezzer catheter. Immediate convalescence was uneventful and the patient was discharged in good condition on the twentieth day.

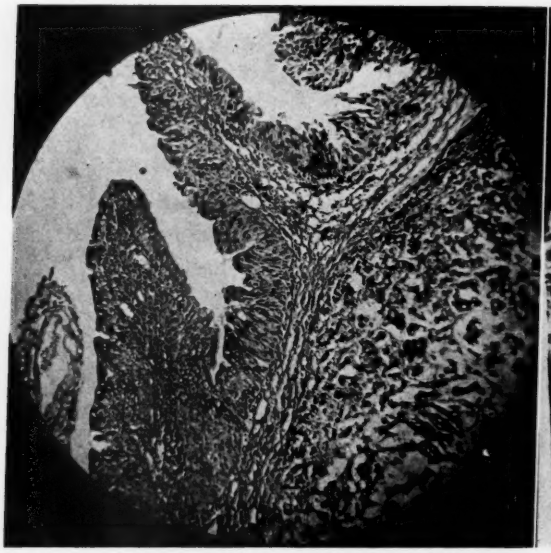

FIG. 1. Delicate villi lined with transitional cells; bladder wall invaded by neoplasm (low power).

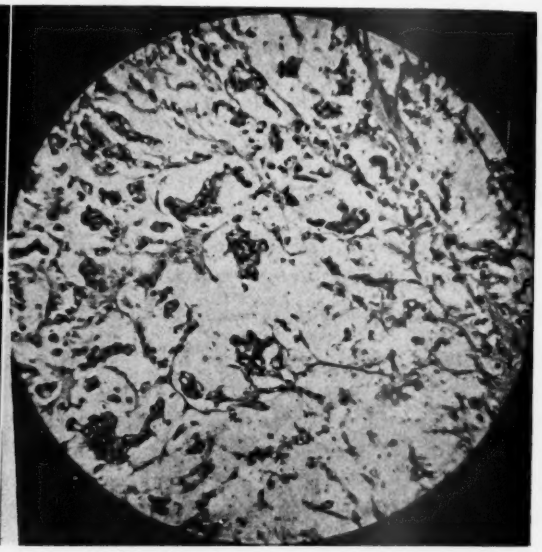

FIG. 2. Alveoli and cords chaotically arranged with conspicuous mucoid material (low power).

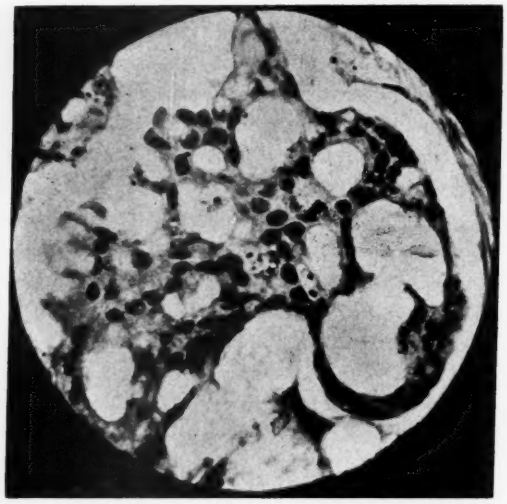

FIG. 3. Cells proliferating to form lateral sacculation; cells are vacuolized and mucoid material conspicuous (high power).

Pathologic Report. Gross description. The specimen, received in 10 per cent formalin, consisted of a membranous mass of tissue designated "anterior-superior portion of urinary bladder" which measured 4.3 by 4 cm. in diameter. The peritoneal surface was slightly roughened by fibrous tags. The mucosa was slightly trabeculated and its central portion presented a soft sessile mass measuring 2.3 cm. at its base. The central portion was ulcerated and slightly brownish. Section through the tumor revealed two-thirds of the musculature to be invaded by a translucent, granular tumor tissue which undermined the adjacent covering mucosa. One cm. posterior to the large tumor and connected with it by its base, was another similar mass which measured 0.4 cm. in diameter. The adjacent mucosa was trabeculated and markedly hyperemic.

Microscopic description. Sections showed delicate villi lined with six to eight layers of transitional epithelium limited by a definite membrana propria. The stroma was loosely arranged connective tissue with dilated blood vessels and a number of inflammatory cells. As the tumor was approached, the mucosa was abruptly interrupted by necrotic tissue, underlying which were pseudo- or glandular acini lined with low columnar epithelium often proliferating to form secondary alveoli. The nuclei were hyperchromatic and basally placed. The cytoplasm was faintly eosinophilic and often vacuolized. The glandular pattern was frequently lost and the cells were arranged in solid masses or cords; here the intracellular mucous material was more conspicuous as manifested by the presence of signet ring cells.

Even in this area, a tendency to glandular formation was noted. In places, the cellular element was absent and the scanty stroma supporting the preexisting glands was striking for the presence of mucous material. Mitotic figures were occasionally seen. The underlying two-thirds of the bladder musculature was invaded. Hemorrhagic and inflammatory areas were conspicuous throughout. The pathologic diagnosis was mucous carcinoma.

In view of the above report and with the realization that secondary invasion of the bladder by mucous adenocarcinoma from other organs was not uncommon, investigation of the gastrointestinal tract was performed. Proctoscopic examination and barium enema produced negative results.

Follow-up. Cystoscopy on June 8, six weeks postoperative, showed no evidence of the former or any new growth anywhere in the bladder. The wound was well healed, the patient looked and felt well and had resumed his usual vocation. Good health and freedom from symptoms continued until the middle of October, 1936, six months postoperative, when bleeding reappeared together with urgency and dysuria. Reëxamination at that time revealed an extensive tumor covering about 4 to 5 cm. of the vault of the bladder; it appeared ulcerated, covered with slough and deposits. Generalized infection was apparent elsewhere in the bladder; the inguinal nodes were enlarged, matted and formed a tumor of considerable size in the right groin.

From then on the patient's course was rapidly downhill. He became bed-ridden and two months later the right leg became painfully swollen from the ankle to groin, the inguinal lymph nodes increased in size to form a hard firm palpable tumor which was apparent well above the inguinal ligament—the tumor mass increased in size progressively. The patient died on January 28, 1937—just one year from the onset of the initial symptom. We were unable to obtain permission for an autopsy.

COMMENT

The histogenesis of this tumor is not known. It is extremely difficult to draw any conclusions from the few cases reported. The reviews of Campbell Begg[1] and Lee[2] adequately cover the etiology, symptomatology and incidence of this neoplasm.

This case presented several unusual features. Because of lack of microscopic confirmation of what seemed to be a clinical papilloma, it was deemed necessary to have the patient checked within ten weeks.

The rapid recurrence of the tumor in a resectable portion of the bladder made radical surgery imperative.

The final diagnosis of primary mucous adenocarcinoma of the bladder rests upon histologic findings, and negative exploratory laparotomy, proctoscopic examination and barium enema.

The innocent appearance of the tumor, the rarity of primary adenocarcinoma which accounts for merely ½ of 1 per cent of all bladder tumors[3] and the inadequacy of our first biopsy, greatly contributed to a rapid and fatal termination.

CONCLUSIONS

1. Primary mucous adenocarcinoma of the urinary bladder is extremely rare.
2. Its tendency to early metastases and extreme resistance to radiation should warrant the classifying of the vast majority of cases as type III, Broders.
3. In this type of tumor, radical surgery in an accessible portion of the bladder is the only hope of prolonging life.

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NEW INSTRUMENTS

THE ALBEE-COMPER FRACTURE TABLE

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THE rapid growth of orthopedic, traumatic and reconstruction surgery during the last few decades has brought very exacting demands upon the methods of holding the patient under traction both before, during and after open operation or closed manipulative procedure upon any part of the body, particularly the extremities and the spinal column. The required demands are multitudinous in variety and most exacting in the precision necessary. Not the least of

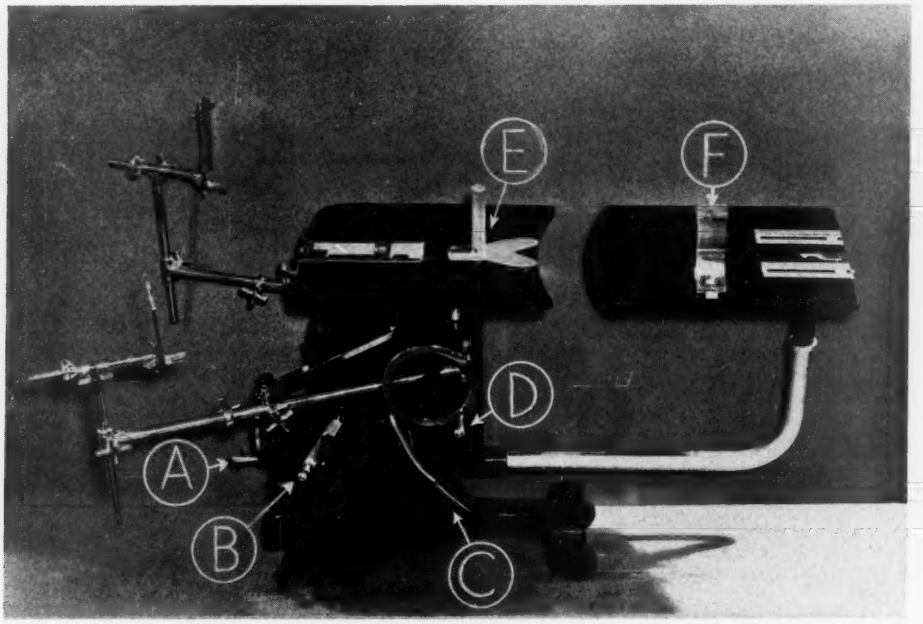

FIG. 1. The table in lateral tilt with head and buttocks section of the table top in position. The foot section is shown removed. Thus an assistant surgeon may be stationed between patient's legs in closer relation to the operating surgeon. Controls are indicated by A, Trendelenburg, B, lateral tilt, C, hydraulic handle for height adjustment of the entire table top and traction, D, control for lowering buttocks section of table top. For easy application of plaster hip spica cast, the head section of table slides back far enough to extend the cast to the axilla. Ample depth is provided so that there is no interference with placing the cast on an obese patient. Provides for overcoming posterior displacement of a short lower fragment of the femur. By placing a wood block or sandbag between the offending fragment and table top it may be levered into place by a turn or two of the wheel while internal fixation agent is applied. Similarly the rotation of the pelvis may be controlled by placing a block under the hip which may then be raised in relation to opposite hip by this movable portion of the table. Conveniently provides self-retaining retraction at lower edge of incision in open reduction work, the end of double rake retractor being hooked under draped edge of table top which, when lowered, automatically holds incision open. An important innovation is the application of control D in conjunction with the removable overhead frame as a crane at the end of the table, one of the principal uses of which is to provide positive gravity traction in Sayre suspension, as shown in Figure 2. E, perineal post and sacral rest are *x*-ray penetrable. F, body support used in lateral tilt.

these requirements are those developed in the treatment of various fractures and dislocations.

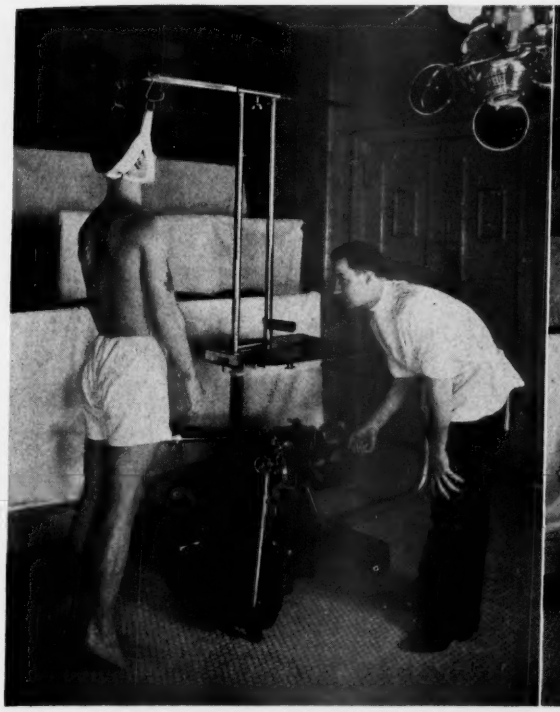

Fig. 2. Sayre suspension under control of crane for applying body cast, etc.

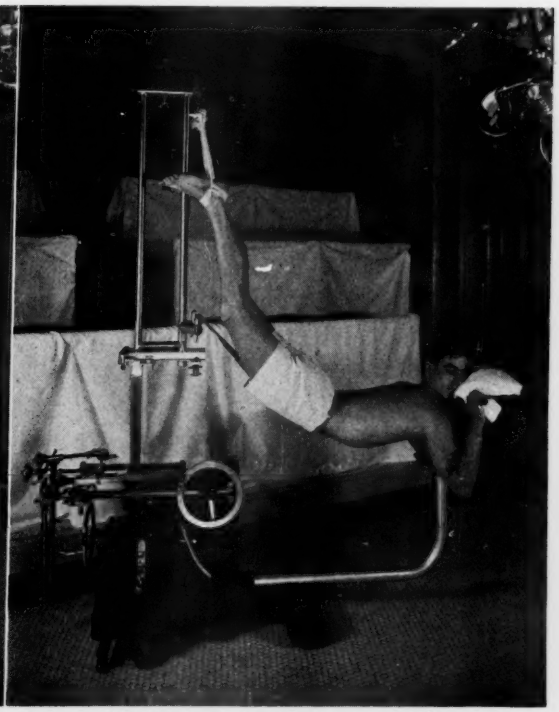

Fig. 3. Hyperextension treatment of fractures of spine (Davis position). A winch with canvas sling is placed in sockets on table top and when patient's legs are attached to overhead frame the table sections may be removed and hyperextension obtained by slackening canvas through control of winch. Precision control of desired posture and crane control D in vertical direction at foot of canvas enable sling to hug symphysis closely for accurate application of plaster jacket. Note that ample space is provided under abdominal region for management of obese patients in hyperextension and for *x*-ray or fluoroscopic examination in any plane without disturbing posture or immobilization of patient.

It has been increasingly realized that the innumerable variations of displacement of fracture fragments are due largely to unbalancing of muscular control by the solution of continuity of skeletal bones. Limb posture has been found to be of inestimable aid not only in reducing the fracture, but in the fixation of the fragments after reduction. This is due to mechanical causes, principally to the selection of a posture of neutral muscle pull, where the displacing influence of a muscle is offset by a posture relaxing it, while the traction is simultaneously applied.

It is becoming increasingly apparent that reconstruction and corrective surgery, made necessary by various infections, automobiles, sports or industrial accidents, is now being undertaken far more generally by the profession than heretofore. Much of this branch of surgery is necessarily of a major nature, where operative speed is of prime importance, but the fracture tables at our disposal lack the advantages of a regular surgical operating table, and do not provide proper facilities and adaptability for control of the patient; this, doubtless, is due to their being designed mainly for the reduction of fractures. Conversely, a regular surgical operating table lacks all means of applying traction during or after the operation.

An attempt to add traction apparatus to an operating table led to complication and limitation of general usefulness apart from creating blind spots in connection with *x*-ray and fluoroscopic examination. This experience, however, indicated the desirability of departing from the more con-

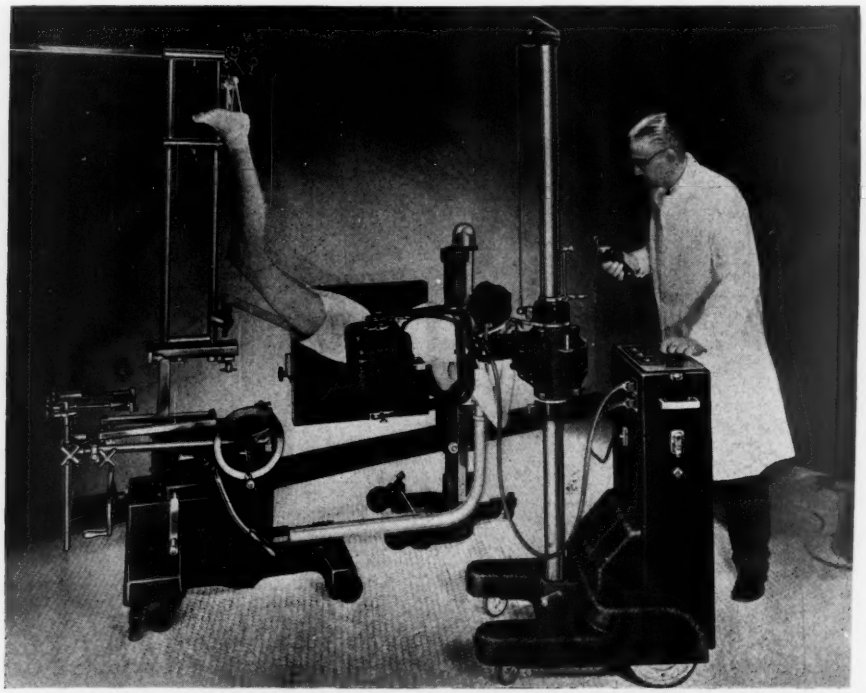

FIG. 4. Lateral radiography with mobile Potter-Bucky diaphragm. For anteroposterior radiograph Bucky diaphragm may be placed at desired angle immediately under patient.

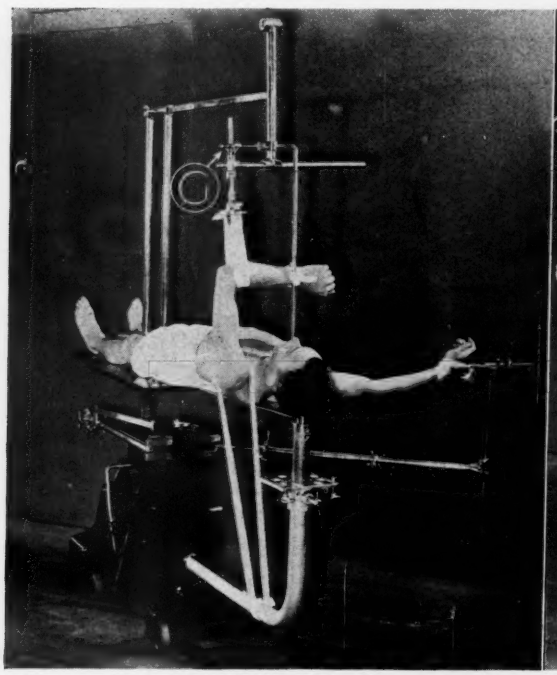

FIG. 5. Anterior elevated position. Turning screw G applies traction, and anchorage to structural tube of table provides very adequate countertraction.

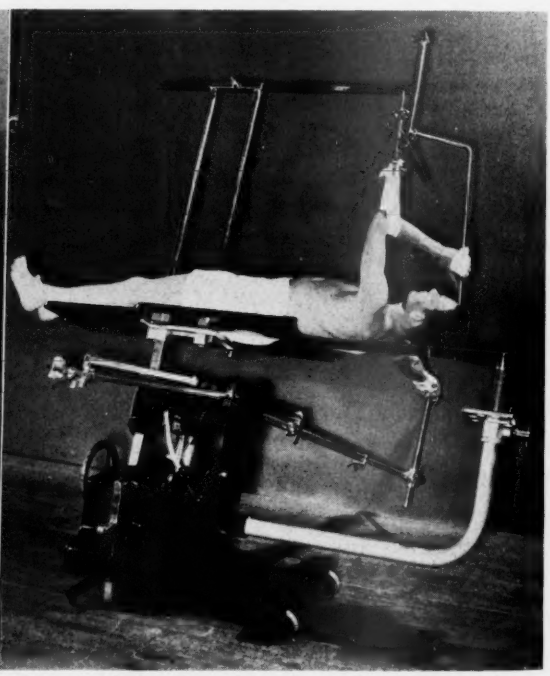

FIG. 6. "Salute" position for arthrodesis or other operation of shoulder. Body support (not visible) is attached to table top at the waist; the most favorable posture may then be obtained by raising table to its maximum height and by placing patient in lateral tilt. This is a great advantage because when operating on any table without lateral tilt, the surgeon must almost stand on his head in order to look upward or laterally into the wound.

ventional standards of fracture table design by adopting those features of the surgical operating table which most usefully apply to traumatic and orthopedic surgery, and combining with them a simple and efficient apparatus for giving comprehensive orthopedic postures under traction, as well as providing for fluoroscopic and *x*-ray examination before, during and after the operation.

Based on this principle, therefore, with the efficient and ingenious aid of an engineer specializing in surgical equipment, Mr. Adrian Comper, I have designed a traction operating-table, which retains from the conventional surgical operating table:

1. Variable height range controlled by a hydraulic pump.
2. Lateral tilt, most advantageous for better positioning of the patient, particularly during hip and shoulder work (open fracture work, extra-articular fusion of the hip, arthrodesis of the shoulder), nailing or pegging for fracture of the hip, and particularly for lateral *x*-rays of such fractures.
3. Trendelenburg angle for spinal anesthesia or treatment of shock during the operation.
4. Compactness and maneuverability.

The combination of the first two exclusive features is of outstanding importance in enabling the surgeon to work with his patient at a height and angle best adapted to the occasion and his comfort.

The controlling mechanism is housed in a pedestal base as an entirely independent unit, resting on casters which may be locked at will. To this pedestal is attached another completely independent unit—a superstructure comprising the table top, traction apparatus, perineal post and sacral rest; consequently, when lateral tilt, for instance, is applied, no distortion or diminution of traction in relation to the patient occurs, and the perineal post and a conventional body support prevent any tendency of the patient to slide out of position on the table. In this superstructure are embodied the following mechanical aids to the management of every desired orthopedic posture of both extremities, as well as the spinal column, whether for open surgery or closed reduction.

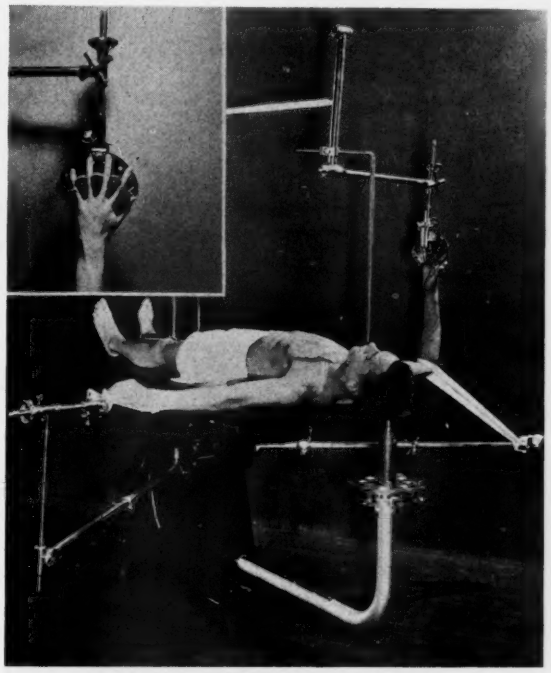

Fig. 7. Airplane position. Insert shows Weinberger hand and arm traction developed for Albee-Comper traction table.

The telescopic traction rods, universally adjustable for both upper and lower extremities, are of new design. They embrace the author's lateral adjustment of the upper end of these traction rods in accordance with the size of the pelvis, or intra-hip joint distance of each individual patient to insure their hinging immediately under the hip joints. The amount of traction thus remains constant throughout the excursion of the traction rods regardless of the degree of abduction or adduction applied. The importance of this device cannot be stressed too highly. The same lateral adjustment may also be used for special purposes such as reduction of fracture dislocation of the head of the femur, through the floor of the acetabulum. When the upper end of the traction rods are spread to their greatest width, the

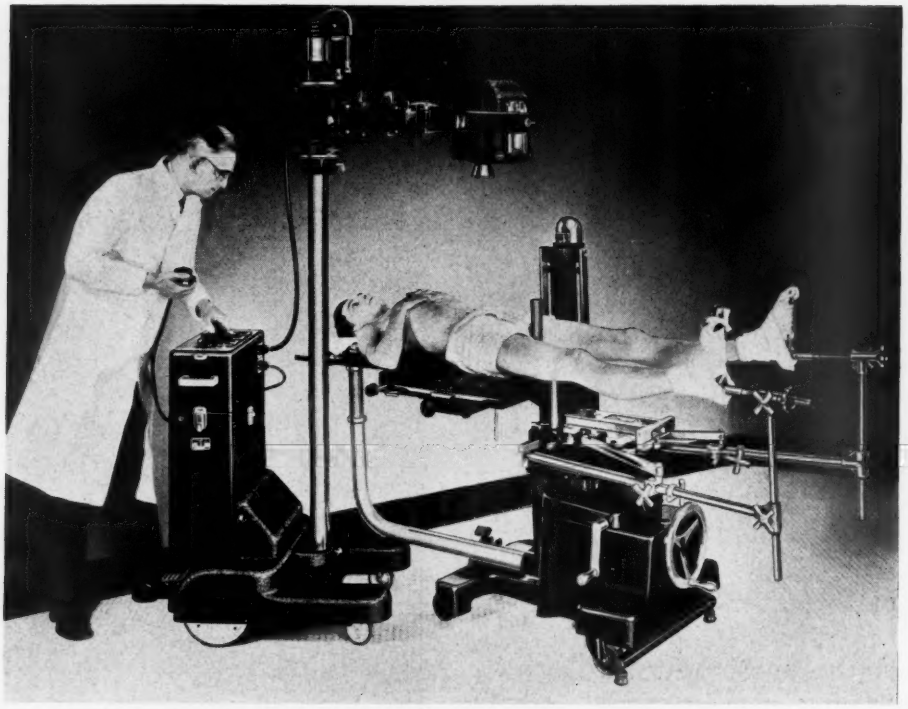

FIG. 8. Shows the advantage of the offset perineal post, making possible full pelvic *x*-ray radiography. Note ample space under patient for insertion of Bucky diaphragm, an application of film to upper third of both femora.

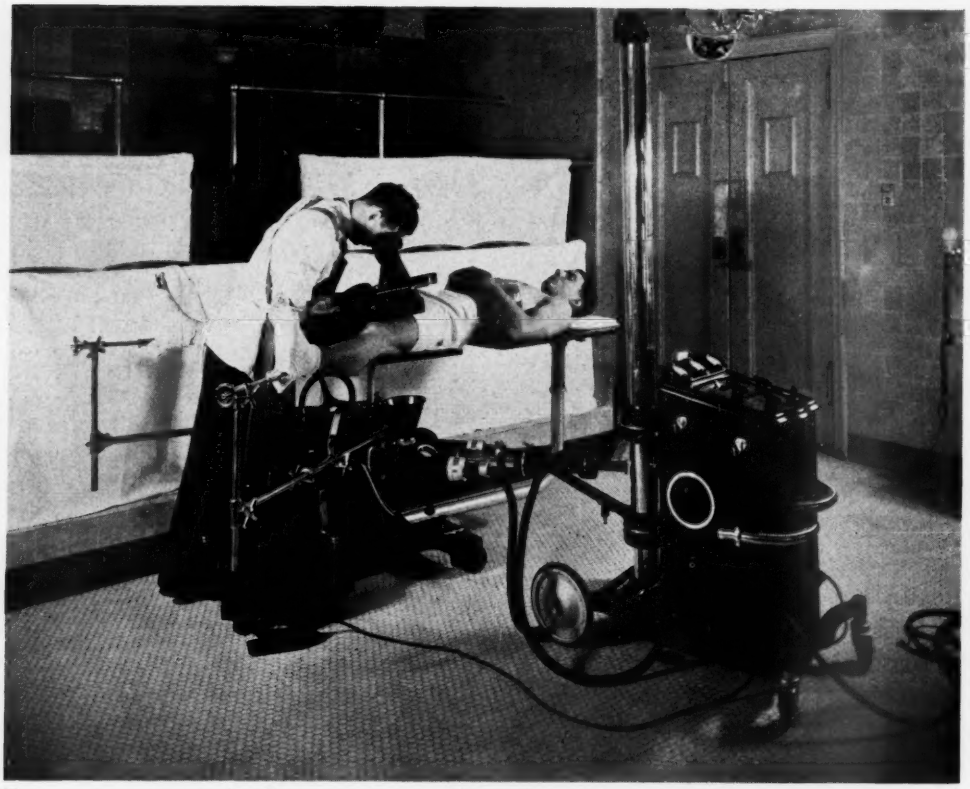

FIG. 9. Anteroposterior fluoroscopy or radiography of femoral shaft. Note uninterrupted entrance between patient's legs for advantageous position of radiologist.

hinge point lies *outside* the hip joint; therefore, the amount of traction is automatically increased as abduction is increased, the maneuver thus providing an effective method of drawing the femoral head back into position through the floor of the acetabulum in the same direction it went in.

Management of Upper Extremities. Complete control of the upper extremity is obtained by substituting a narrow steel plate, readily withdrawn from the plaster cast, for the head section of the table. (Alternatively the hyperextension canvas sling may be used.) Traction arms, universally adjustable for *both* upper and lower extremities, are then swung into position and leg traction apparatus is removed and attached to overhead frame.

Radiography. To allow accurate *x*-ray examinations before, during and after the operation, the perineal post—the datum line of a fracture table—has been carefully positioned in relation to the pedestal base and a unique single tubular support has been adopted for carrying trunk section of table top. These two factors, together with an *x*-ray penetrable sacral rest and table top, now make possible complete radiographic or fluoroscopic survey of the entire spinal column and pelvic area by any shock proof mobile *x*-ray unit. The pedestal base slopes to a narrow top and traction arms have been kept free of protuberances for the purpose of providing unusually comprehensive anteroposterior and lateral views of the shaft of the femur

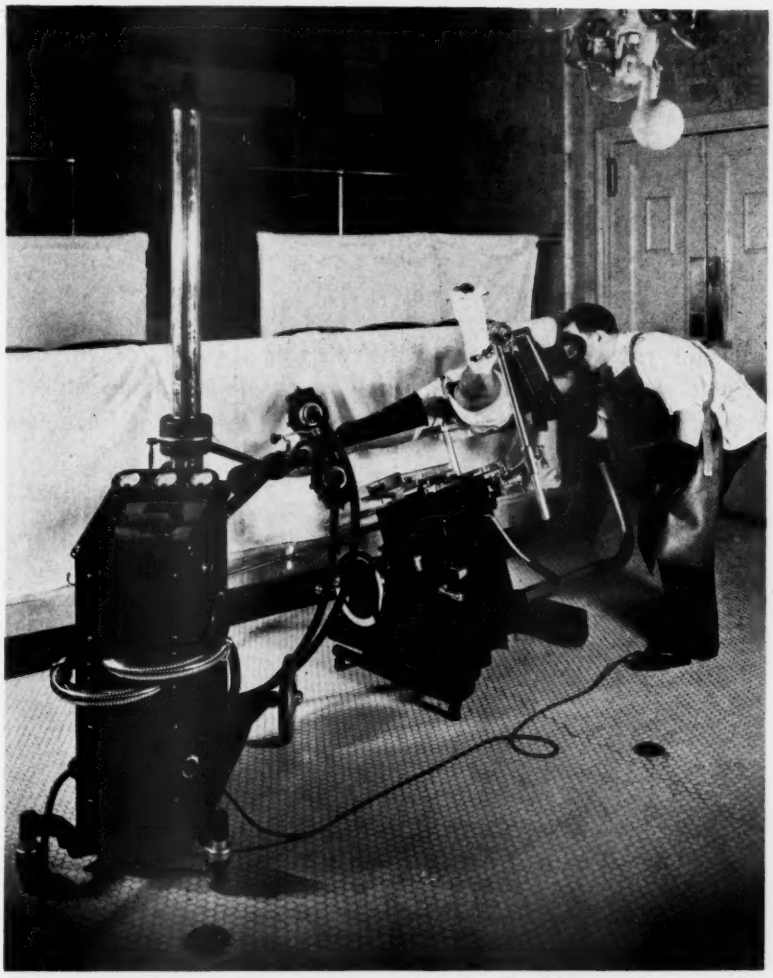

Fig. 10. Lateral fluoroscopy or radiography of neck of femur. Note superior posturing available by means of lateral tilt, which *x*-ray technician has found to be of the greatest help in lateral work on the hip.

and tibia. The importance of *x*-ray check without removing the patient from the operating table cannot be too highly stressed under present day orthopedic and fracture conditions, and the unusually advantageous facilities for this purpose are self-evident from the accompanying illustrations.

It will thus be seen that the combination of many features of the surgical operating table with the conventional fracture table, and the development of additional mechanical innovations, has resulted in the consolidation of the two types of tables as one compact self-contained unit with unprecedented *x*-ray examination advantages.

In all fractures around the elbow the carrying angle of the arm, normally 16 degrees, must be maintained as nearly as possible. This is important to lend support to the elbow and to give strength for carrying burdens in the hand.

From—"Fractures" by Paul B. Magnuson, third edition (Lippincott).

A WOOD TUNNEL FOR SERIAL ROENTGENOGRAMS IN INTERNAL FIXATION OF THE HIP*

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INTERNAL fixation of intracapsular and intertrochanteric fractures of the femur ordinarily requires the taking of several roentgenograms, which require in turn that the patient be shifted about on the operating table. The wood tunnel described has been devised to eliminate the necessity of these repeated changes of position.

The tunnel is a plywood box, open at one end, 1¼ inches high, 24½ inches long, and 13½ inches wide. The upper section at the open end is braced with a strip of metal which extends upward on either side for about 1 inch to form an L. (Fig. 1.)

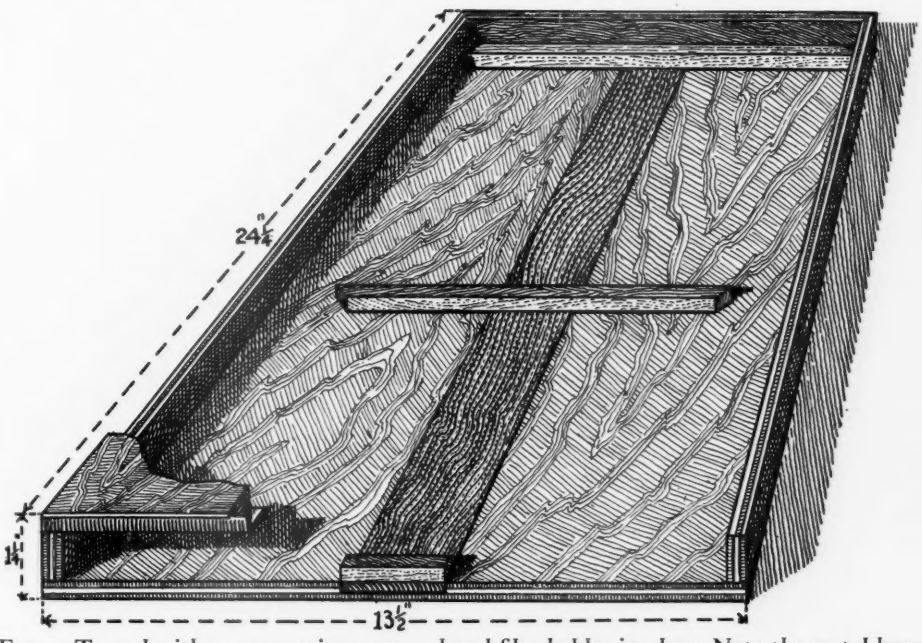


FIG. 1. Tunnel with upper section removed and film-holder in place. Note the metal brace at the open end and the channel through which the plate-holder slides.

In the middle of the bottom section (Fig. 1), extending its entire length, is a channel ⅛ inch deep and 2 inches wide, through which the plate-holder slides. The plate-holder is T-shaped. The long bar, which is 26 inches long, is the exact width and depth of the channel. The crosspiece, set at right angles to the long bar, is 1 inch high and 13 inches long. At the other end of

* From the Department of Surgery of the School of Medicine of Louisiana State University.

the plate-holder a similarly placed piece of wood, ½ inch high and the exact width of the holder, furnishes a grasp for the hand.

damp cloth. The plywood construction allows the rays to penetrate easily and casts no shadow on the film. The device is sturdy in itself, and the additional metal

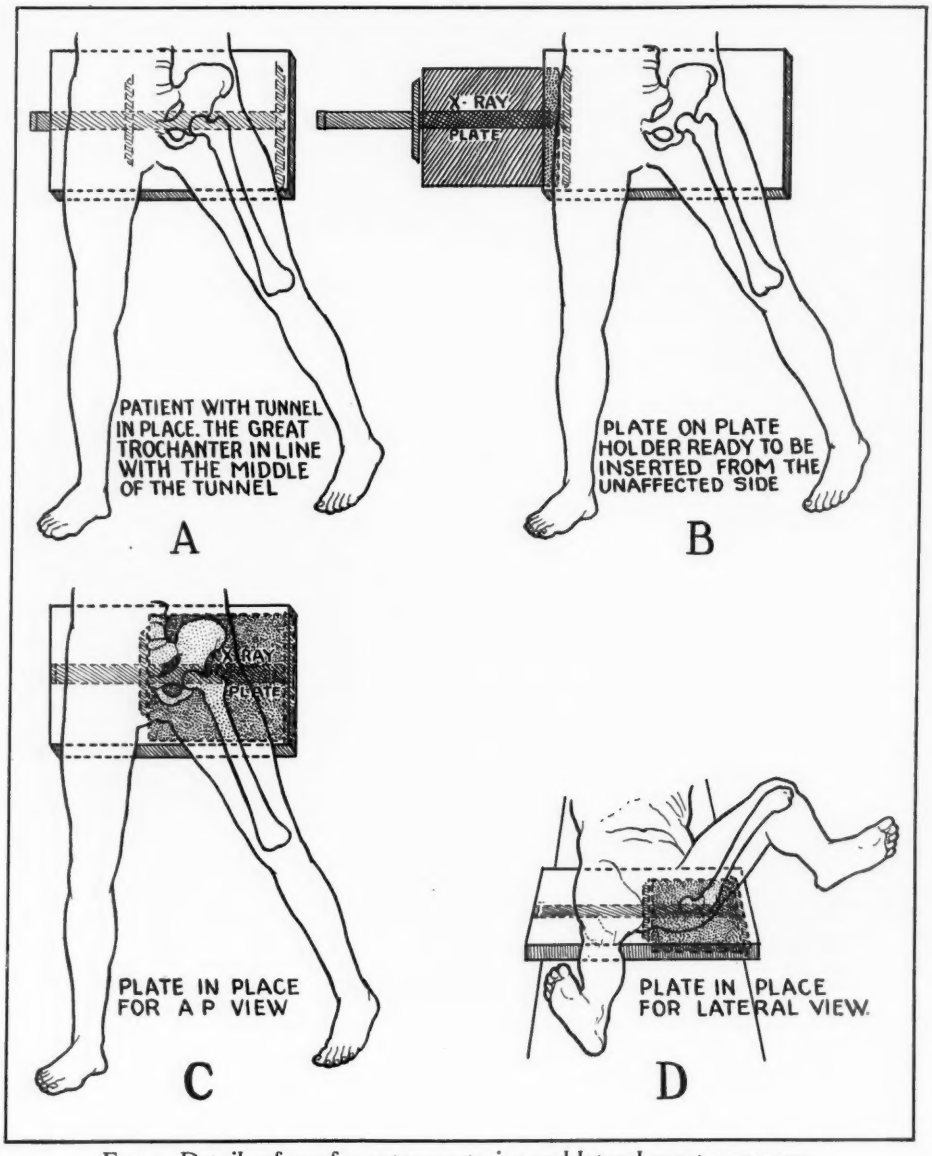

PATIENT WITH TUNNEL IN PLACE. THE GREAT TROCHANTER IN LINE WITH THE MIDDLE OF THE TUNNEL
A
X-RAY PLATE
PLATE ON PLATE HOLDER READY TO BE INSERTED FROM THE UNAFFECTED SIDE
B
X-RAY PLATE
PLATE IN PLACE FOR A P VIEW
C
PLATE IN PLACE FOR LATERAL VIEW
D

Fig. 2. Details of use for anteroposterior and lateral roentgenograms.

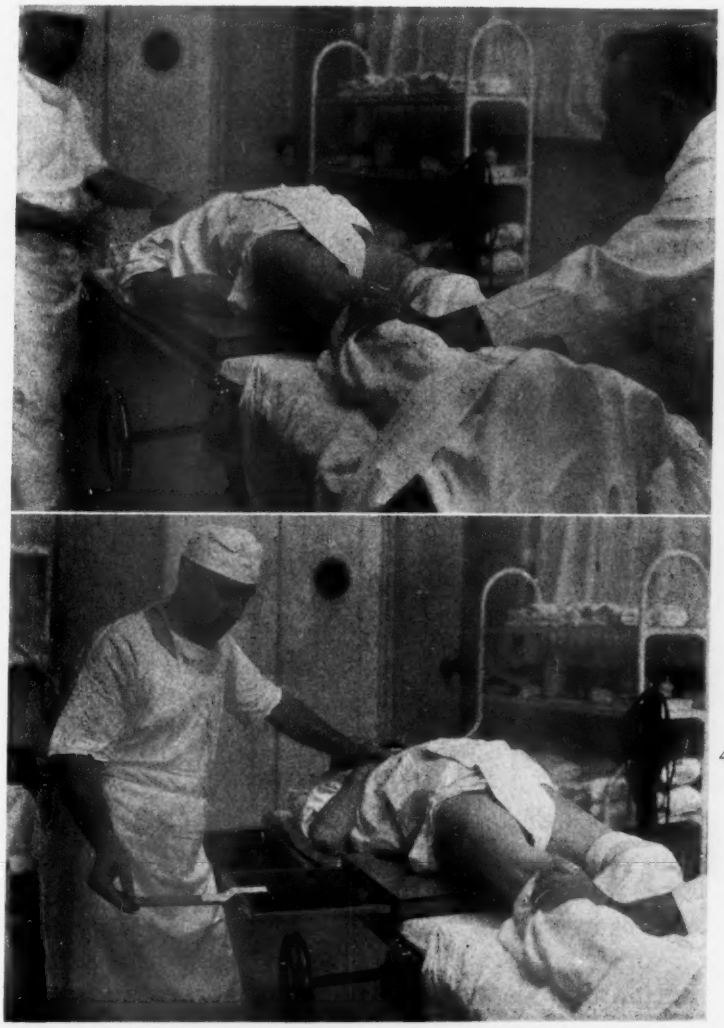
This plate-holder provides for a 12 by 14 inch cassette holding a 10 by 12 inch film. This is held in place by another crosspiece 6 inches wide. If films of different sizes are used, this crosspiece may be removed and the cassette held in place by adhesive.

The tunnel is shellacked, and blood and other stains are easily wiped off with a

brace makes its use possible with patients weighing as much as 250 pounds. The cost of material and making is less than five dollars.

When the tunnel is to be used, it is placed on the operating table, at the level of the hips, with the closed end toward the affected side. The patient lies on it, with the greater trochanter in line with the

middle of the tunnel. Pillows under the back, shoulders, and head bring the upper part of the body to the level of the tunnel. pushed into the tunnel by way of the channel from the unaffected to the injured side, and as many pictures as may be



3

4

Fig. 3. Patient on table with tunnel under affected left hip.
Fig. 4. Plate-holder with cassette and film ready to be slipped into tunnel through channel.

Preparation and draping of the patient are conducted as usual. A film in a cassette is necessary can be taken without moving the patient or disturbing the draperies.

A CONSERVATIVE TREATMENT FOR NONUNION

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PHILADELPHIA, PENNSYLVANIA

THE splint design here illustrated is for the treatment of nonunion of the bones of the forearm. The same mechanism can be assembled on my splint designs for nonunion in fractures of the other major long bones. They conform to the new type of extension and of physiologic conservation incorporated in my splints for the immediate correction and treatment of fresh fracture deformities.[1]

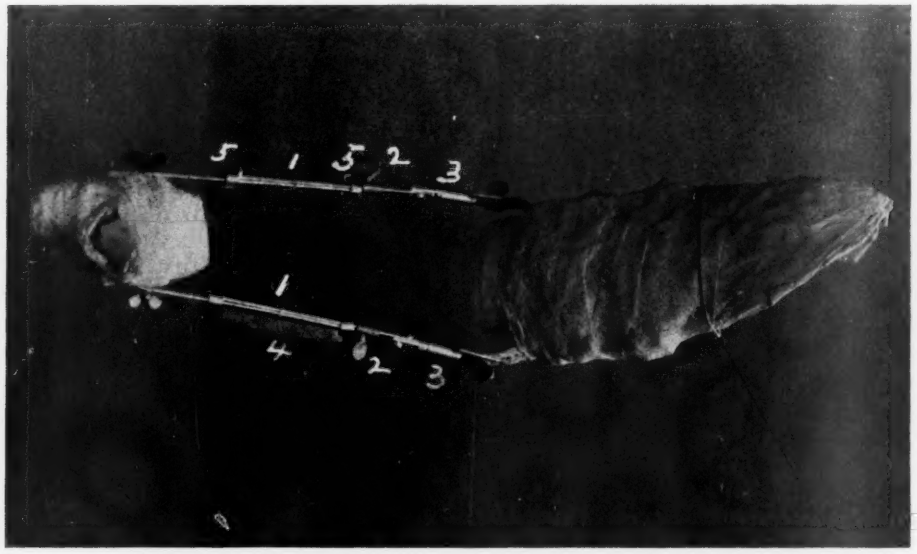

FIG. 1. 1, slidable distention mechanism. 2, stop to prevent shortening of the forearm. 3, rotating devices permit pronation and supination. 4, elastic bands giving continuing distention power. 5, bared hooks accommodating the elastic bands.

The operation of the splint produces a continuing distention of the bone in its normal alignment, with opportunity for both flexion and rotation of the forearm. It proposes to secure by a continuing distention what cannot be accomplished by immediate extension of the injured member.

The distending power is confined solely to the forearm. It is not wasted over more extended areas. Thus less power is required to accomplish the same result.

The distending pressure is distributed along the length of the humerus and upon the carpal and the metacarpal bones. It can be adjusted to stay within the limits of comfort and safety.

The braces or supports for the distention are two unpadded casts. The cast upon the humerus has a soft pad over the vessels in the flexure of the elbow so that these vulnerable structures are protected absolutely from injurious pressure. The cast has a cap extending over the shoulder to prevent a drop that would occur otherwise upon the cylindrical arm. Metal plates with projecting ends are imbedded on the inner and outer sides of the cast at the distal ends. These plates are so placed in the cast that terminal holes in the plates come opposite the axis of the elbow joint. An unpadded cast is moulded to the hand covering the carpal and the metacarpal bones. The fingers are left bare to permit function. Metal plates with projecting screws are imbedded on the dorsal and palmar aspects of the cast.

The distention mechanism (1) is composed of two splint arms on each side of the limb. These splint arms have appropriate

sleeves, each for the engagment of its mate. They can thus slide upon each other. Hooks on these sleeves are for the attachment of rubber bands for the continuing distention. A stop (2) on the upper splint arm prevents shortening of the forearm beyond the adjusted position.

The rotating devices (3) are separate units attachable to the proximate ends of the upper splint arms. They are not needed in the treatment of major long bones other than those of the forearm. The distention rotation mechanism is attached to the arm and hand casts as shown in Figure 1.

With manual traction the forearm is stretched and this degree of distention is held by adjusting the stops. Additional distention power to the limit of comfort is secured by stretching rubber bands (4) between the hooks (5) upon the splint arms.

The patient is encouraged to use the limb. It will be noted that the splint arms substitute for the broken bones. They give a stability in normal alignment and permit the exercise of more power and a greater degree of usefulness of the arm. Controlled function of the arm gives greater encouragement to nutrition and hence to bone regeneration.

If with a satisfactory approximation of the fragments bone union does not occur after a full probationary period, one can consider the advisability of plunging a trocar and cannula between the fragments. With the trocar or with a rasp the bone ends can be denuded and the intervening fibrous tissue broken up.

I propose this method of treatment patiently pursued for a lengthy period as a substitute for the more radical operative procedures with their attendant uncertainties and dangers.

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1. Masland. *M. Rec.*, Sept. 19, 1934.

[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

HUGO OF LUCCA AND THE SCHOOL AT BOLOGNA

INCUNABULA MEDICA IV

FELIX CUNHA, M.D.

SAN FRANCISCO, CALIFORNIA

WHEN, because of war with its later discrimination and persecution of the defeated, it became necessary for the studious minded at Salerno to seek refuge elsewhere, there were open to them three avenues of refuge. First of these was the University at Montpellier in France, at that time in the process of growing, not yet within reach of its great fame which was to come later. Secondly, there was the University at Paris, in about the same situation as Montpellier, yet a bit closer to its zenith than the former. This later fame was to result from the very conditions causing the eclipse of Salerno. Several brilliant minds of the century came to the Paris faculty who would have gone to Salerno otherwise.

The studious intellectual mind, more particularly if of a philosophical bent, requires for working a scene of peace and tranquility that there may be opportunity for deep speculation with freedom from such environmental factors as discipline, dictation, regimentation, persecution and strife. Apparently conditions have altered little from those days of 700 years ago, since today in our own times we see an exodus of just such personalities from one part of the world and a migration to another, seeking exactly that same haven of peace and solace. One such brilliant personality at Salerno, seeking a new haven where he could work in his own manner, is interesting since he furnished a link in the chain of the dissemination of medical knowledge. Probably because he was a loyal and patriotic Italian, and perhaps because of the much shorter journey necessary from Salerno, this individual chose not Paris or Montpellier, but the third of the available possibilities, the University at Bologna.

The part which it is possible for a single great mind or a great teacher to play in the field of art and science has been repeatedly demonstrated throughout history. In the days of the early centuries, students flocked from all parts of the known world to a great teacher or a great master. Where they gathered in sufficiently large numbers and the faculty was of outstanding caliber, a center of teaching grew, or a university, and it was in such manner that Bologna began and grew.

One particular individual who was to be instrumental in helping its growth and fame, was Hugo, who, because he came from the Italian town of Lucca, was called Hugo of Lucca. As a surgeon he was not

without training or experience, having been associated with those two great names of the twelfth century, Roland of Parma and Roger of Salerno for many years. Bold daring surgeons were these latter and neither the teachings of Constantin, nor the school of Salerno could influence them. Their work was of such outstanding brilliance and accomplishment, that they could stand entirely alone and unaided without any reflected prestige from any university, even the famed Salerno.

Among their many contributions they described syphilitic or venereal lesions almost 300 years before Columbus returned from America (another nail in the canard that syphilis had its origin among the Indians in America and was brought back into Europe by Columbus' sailors). They described the lesions of cancer, particularly superficial skin cancers, quite accurately. Internal cancers more often they confused with syphilis, yet that is done even today.

The use of seaweed, the eating of it or decoctions of it in the treatment of swellings of the neck, such as in goiter or tuberculous adenitis was advocated by both. In other words they "Iugolized" their goiter patients as we do today, except that manufacturing facilities not being available, they obtained their drugs in the crude stage and so used them. Laudatory biographies of both these brilliant personalities have been written by many students of medical history and are available to those who wish to read more about either of them.

The consensus of opinion among students of medical history is that Hugo of Lucca surpassed even his teachers, because they followed more or less blindly, dogmatically and unquestionably that which had been set down in manuscript by their illustrious predecessors, whereas he possessed a faculty of questioning everything, of applying a certain practicality to everything, every formula or procedure, simplifying it, and discarding that which he found not true in actual practice.

In the practice of medicine there have been from time to time such men. They fail to follow in the groove of custom because their own judgment tells them not to. There have been and there will always be great practical teachers of medicine who devote their entire time to study and teaching and practice, like Hugo. Having little time to write or express themselves on paper, their passing from the scene is usually marked by a sparseness of available writings. Posterity suffers thereby, but these men are usually so practical-minded that the wide publication of one of their methods, which to their own thinking is of such utter simplicity as to be almost ridiculous, is distasteful, savors of personal aggrandizement, and they look upon it with disdain. So it was with Hugo. Exceedingly small is the amount of his writings which can be authenticated, though he lived and practiced until he was about a hundred years old.

One fortunate circumstance lessened the possibility that all his work would be lost. He had several sons, four of whom decided to make medicine their field. One, Theodorich, called Theodorich Borgognoni, he was particularly attached to and made him his intimate associate, assistant and confidant.

Because of a feeling that the teachings of his father should be made known to the scientific world, Theodorich took it upon himself to gather together and publish several tracts, the most famous of all being a "Cyrurgia." Two hundred years or so later, in 1498 and 1499, these were gathered into print and published in Latin in Venice and in French in Lyons. These two items today form very rare incunabula, difficult to obtain at almost any price.

Due to the constant interchange of ideas, practice, and writings of father and son, Hugo and Theodorich are usually spoken of together and their writings are considered jointly.

In order to understand why Hugo of Lucca is considered as one of the greatest of his contemporaries, an examination into some of his surgical ideas and procedures is of help.

First, and perhaps most simple, were his ideas as to the etiology of headaches. He distinguished them as being either of brain origin or derived from a state of disturbed digestion. He stated, "Those found to be due to some cause within the skull or in the brain itself, such as might be caused by the pressure of a tumor, will be found to be constant and continuous, without any relief whatsoever, even for an instant, while those arising from a disturbed state of digestion will be found to have intervals of complete freedom, then very intense and severe intervals dependent entirely upon the state of the stomach."

Because war and civil combat were the order of the day, the most common injuries were those occurring from bludgeoning of the skull by heavy weapons wielded with great force and producing all types and degrees of skull fracture. It was obviously necessary that the surgeon of the time be most experienced and skilled in the handling of such a type of injury.

The next most common type of injury was that caused by arrows. These wounds called for no end of ingenuity on the part of the surgeon. The making of arrow heads invariably exhibited an unusual degree of malicious invention. Some were made in such a manner that when they penetrated into the flesh they could not be withdrawn without extensive incision into and damage of the tissues for a considerable surrounding area. In such cases Hugo evolved a technique entirely his own. He made no attempt to extract the arrow immediately upon penetration, endeavoring first to disinfect the wound with hot wine applications. Then in a few days as the muscular rigidity relaxed, it was easier to extract the arrow head, often without any additional incisions whatever. Theodorich, in describing this method of his father's relates, "Once I saw two strong men make efforts to extract an arrow from the body of one who had been so injured. Despite their great strength they were unsuccessful and the injured one was brought to my master, Hugo. By the application of his usual remedies in a few days the arrow withdrew almost of itself."

When it is considered that every ingenious expedient that the brain of man could devise was used to tip these arrow heads, such as dipping them for long periods in poisonous concoctions or smearing them with known poisons, anything that would increase the deadliness of the weapon, then it is not hard to visualize that the problem of wound infection and its handling was no minor one.

Here also he had his own particular technique. All wounds were dressed with wine, and he emphasized that it was important to use the best possible wine that could be obtained. In the hands of an honest individual this admonition was probably very wise. It has been related that contemporaries and followers of Hugo carried out this admonition with rather shady results, setting aside the good wine for personal consumption and using for the wound any other that was at hand. Human behavior down through the centuries has probably been no better and no worse.

Hugo described the penetrating wounds of the chest caused by arrows, the resultant empyemas, the complications of rib fractures, the lung abscess and lung gangrene which often followed. He reached a peak of surgical accomplishment by performing a complete lobectomy, although involuntarily. In describing this particular case, Master Hugo relates:

"There was a nobleman living in Bologna, named Domicellus whom I was called upon to treat. When I arrived within the walls of his house the stench of rotting flesh was of such intensity that I thought it almost unbearable. On approaching his bedside, I noted that his once huge frame had shrunken to an almost unbelievable degree, both from the nature of his wound and from the wracking of his body with pain. As I stood there, he coughed up quantities of the most foul smelling substance in which were great pieces of substance and when I examined his wound which was an enormous one of his chest,

I could see the putrefying substance of his lung and I noted that that which he coughed up was exactly the same as I could see in his wound. As I proceeded to dress his wound according to my usual procedure I thrust my hand into the wound and on withdrawing it found that it contained such a huge portion of lung substance that I became alarmed. However, I was able by my method to heal this man completely even though a part of the lung was lost."

In the treatment of wounds Hugo very often differed from the strongly entrenched medical authorities, but he was very careful always to mention wherein he differed and why. He casually mentioned that he was quite aware that Galen or Avicenna recommended some other procedure or strongly advised against the very steps he was using, but then he cited his reasons, and, as though to clinch the matter, gave names and places where he cured so and so by this very method. Nothing could be more convincing.

His son, Theodorich, who was working with him constantly and absorbing as much of his father's wisdom as he could, speaks of the treatment of these wounds thusly: "When a white pap-like fluid runs out of the wound, then things are not too well, and when a very thin serous-like fluid comes out then there is great danger, but one must not despair wholly because I personally have healed such men following the treatment advocated by my father and I have seen a great many who showed the above mentioned signs healed by him."

The third type of traumatic injury most commonly met with was that caused by the sword. These wounds varied from minor lacerations to cuts of extreme degree. If one has noticed in the museums the varying type of weapon which came under the heading of sword, one can well visualize the extent of injury which could be inflicted by a husky expert wielding such an instrument, particularly those enormous two handed and double edge blades.

Hugo describes the wound produced by just such a two handed affair wielded by a giant of a man which caught his opponent across one side of the skull. Not only did it trephine him, but it accomplished a partial decerebration much the same as that achieved by our research men with great pains. The victim did not die, much to the astonishment of Hugo himself and the physicians of Salerno. The latter had refused to undertake his treatment, forcing him to journey to Bologna to Hugo.

In Hugo's treatment of this case he stressed the necessity for the utmost cleanliness in and about the wound, the careful shaving of the surrounding skull, the wisdom of avoiding the probing of such a wound needlessly or too many times. The actual treatment was to fill the cavity with a consecrated oil, "olei consecrationi," then to apply a pressure tamponade, snug and firm but free from any unnecessary force. Theodorich, in describing this particular case states, "One ventricle of the man's head was totally empty of brain substance, nevertheless he was healed by my father Hugo who restored the brain substance by flesh (this presumably means connective tissue) and as it was the cellule of memory I noted that he was very astonished that the man retained his memory as before."

This entire description one can accept with the proverbial grain of salt.

Theodorich stressed the fact that these types of wounds when treated by his father from the very beginning and dressed only by himself, invariably did well. This leaves, one presumes, a loophole for Hugo, because his cases invariably came from a distance and had been treated in some form or another by other surgeons in other localities. The lack of success, when it did occur, could thus very conveniently be shifted back to the original physician. The same type of alibi is used today with not the slightest deviation in method.

As can well be imagined, Hugo's success with such outstanding cases as the man with the gangrene of the lung and the other with the loss of brain substance brought

him a fame far beyond the geographical borders of his town and his country. His practice grew enormously and he was called everywhere in consultation.

tions of Avicenna. It seems that Avicenna advocated attempting to sew the structures together whereas according to Hugo perfect approximation of the structures by

PROLOGVS

CHIRVRGIA EDITA ET COMPI
lata ab excell. domino fratre Theo-
dorico episcopo Cerulensi ordi-
nis prædicatorum.

Capitulum proœmiale.

VENERABILI patri & amico charissimo egregio viro dño .A. dei gratia episcopo Valētiñ. frater Theodoricus eiusdem patientia Botontiñ. ecclesiæ minister indignus: opus diutius affectatum. Dudū pater charissime, Romę pariter existentes, me vestrum tunc temporis capellanum et pœnitentiariū domini Papæ affectuose rogastis: vt vobis quædam artis medicinæ chirurgiæ, scilicet occulta & implicita, & ab antiquis imperfecte dicta, librum super hoc faciens secūdum medicationem domini Hugonis de Luca uiri in prędicta scientia peritissimi, aperte descri[bere]rem: & breuiter explicarem. Ego vero volens in [parte], & si nō in toto satisfacere votis vestris, librum [in]cēpi edidi: quem eo tempore, sicut nostis, imperfectū & incorrectum morę impatiens vobiscum in Hispaniam deportastis. Rogantes, et postmodum per nuncios crebris literis expetentes, vt vobis eundem librū suppletis defectibus trāsmitterem emendatum: diu distuli. Sed ecce iam appropinquante senio, Christi auxilio inuocato ipso duce artis chirurgiæ secreta deposito omnis liuoris aculeo apertissime manifesto. Suscipe igitur pater charissime opus exiguum, imo opus eximiū, breue corpore, viribus amplū. Quia vero modico valde tempore fui cū domino Hugone prædicto, neque videre, neque comprehendere, neque discere ad plenum potui expertissimas curas suas: ideo in parte ista imperfectum meum ex propria experientia, & antiquorū curabo perficere, Galeni maxime, quem a prædicto viro eximio in nullo nouimus discordare. Vt autem ad librum istum accessus facilior habeatur, quid sit chirurgia, vnde dicatur, quales operatores habere debeat, necnon quę sit ipsorum intentio, & in quot diuidatur species, breuiter denotabo.

Chirurgia igitur est operatio manualis in corpore animalis ad sanitatē tendens: Vel sic. Chirurgia est vltimum instrumentū medicinæ. Tria enim sunt instrumenta medicinæ, quibus mediantibus, morborum causis valet medicus subuenire, scilicet dieta, potio, & chirurgia. Dieta est primum instrumentum: & est melius, sicut testatur Gal. in cōmē to regiminis acutorum dicēs. Si possumus hominem curare cum dieta: non curemus eum cum aliqua potiōe. Et Damas. in Aphoris. Si poteris hominem cura re per dietam, prosperam inueniens: hoc autē instrumentum siue regimen exigitur contra causam, & facit digestionem. Secundum regimen seu instrumē tum est potio: de qua idem Gal. Si cum potione infirmitatem possumus remouere, ad chirurgiam recurrendum non est. Si autem per duo prædicta regimina seu instrumenta remoueri non poterit: remoueatur beneficio tertij regiminis: videlicet chirurgiæ.

Dicitur autem chirurgia a cheir quod est manus: et ergein quod est agere: inde chirurgia, quasi manualis operatio.

Oportet operatores chirurgiæ, vt dicit Halyab. in commento, frequentare loca: vbi periti chirurgi operentur, & eorum operationes diligenter attendere, et memoriæ commendare. Oportet etiam vt non sint temerarij, neque audaces, sed sint prouidi, suaues, & cauti: vt cum maxima deliberatione & suauitate omnimoda, qua potuerint, operentur: & maxime circa cerebrum, panniculos, membra neruosa, & loca alia timorosa. Et quia in libris comprehendi non possunt omnia quæ necessaria sunt ad artem: & frequenter multa operatori occurrunt, quæ non potuerunt de facili prouideri: oportet medicum ingeniosum esse. Damas. enim multum cōmendat in medico ingenium naturale, dicit enim. Ingenium medici naturale adiuuat artem, & naturam regentem. contrario vero contrarium. Oportet etiam esse literatos, alias, et si interdū experimentis iuuentur, frequenter tamen in errorem incident, & labyrinthum. vix enim aliquem sine literis puto posse comprehendere chirurgiā. Refert enim Almāsor, q̄ operatores huius artis pro maiori parte idiotæ, rudes, & stolidi sunt: & causa stoliditatis eorū ægritudines in hominibus pessimę generantur. Plerunque etiam cum non operantur sub certa radice, neq; rationabiliter propter ipsorum imperitiam homines occidunturi Causas etiam, & nomina infirmitatum quas asserunt se sanare, penitus non agnoscunt.

Intentio operationis chirurgorum est circa tria, scilicet circa coniunctionem solutorum, circa separationem cōiunctorum præter naturam, & circa extirpationem superflui.

Species chirurgię, sicut testatur Ioānitius, duę sūt. Dicit enim, chirurgia est duplex: aut i carne: aut in osse. Et secundum contrarietatem membrorum subiectorum: nam alia fit in membris mollibus, vt in carne, neruis, venis, & similibus. Alia fit in membris duris, vt in ossibus, & consimilibus: quæ sicut differunt in contrarietate qualitatum, scilicet mollicie. & duricie: sic et in omni operatione chirurgica. Chirurgia quæ fit in membris mollibus, subdiuiditur tripliciter: aut fit in carne tantū, quæ scarificatio, vel incisio, seu sutura, aut incisio nuncupatur. Aut fit in uenis nō pulsantibus: aut in pulsantibus: & dicitur phleboromia siue sectio. Aut fit in neruis secūdū latū, et tūc incisio noīatur. Aut secūdū longū, & tunc punctura dicitur vel scissura. In diaphragmate tñ & panniculis, nomi-
natur ruptura. Chirurgia vero quæ fit in membris duris, duplex est: aut enim fit in ossibus duris, & dicitur restauratio siue consolidatio fractorum: aut fit in ossibus dislocatis a loco proprio, & appellatur coniunctio disiunctorum.

Vt autem quod vnusquisque voluerit, valeat facilius iuenire: diuidemus in quatuor particulas librum istum ordinate per capitula partes singulas distinguendo: ita tamen q̄ in prima parte huius libri non in speciali, sed sub quadam intendimus generalitate tractare.

Diuiditur autem liber iste in quatuor partes. In prima parte agitur vniuersaliter de vulneribus, vlceribus, de fluxu sanguinis, & medicinis ipsorum, de iudicijs mortis, de vulneribus neruorum, cura apostematis calidi, atque spasmi. In secunda parte tracta-
tur

FIG. 1. Page from Hugo and Theodorich's "Cyrurgia."

There were apparently many deep sword wounds of the neck, often involving the great vessels, the direct sequel of attempts to decapitate the opponent. Here Hugo's therapy was unique and individualistic. According to his custom, he humbly apologizes for his technique, stating that he knows he is contrary to the recommendapressures and pads was all that was necessary.

In the treatment of ordinary lacerations or cuts he was considered a master. His approximation of edges was so perfect, that his son often stated, "My master Hugo heals and consolidates all wounds with wine and compresses, making a convenient and

artistic dressing which he knows how to do so well, thus producing the most beautiful cicatrices without the use of either sutures or salves. No ragged or stringy cicatrix ever remained from the wound or abscess of a man he had treated himself. In conformity with this I have never seen a single broken or cut blood vessel which he was not able to close by the use of such a dressing."

Apparently the greater proportion of these civil and war traumatisms were not superficial, but penetrated deeply as Hugo describes. He stresses the painful symptoms which accompanied the enclosure of a cut nerve ending in a scar. However, he did not advocate the suturing of the cut ends of nerves even though they were easily visible and it could be done very readily. He claimed that his method of treatment by pressure and approximation was efficacious in all wounds whether nerves or blood vessels were involved or not.

He recommended the most exact conjunction of the surrounding tissue, this approximation to be maintained by little "cushions" (compresses?) which acted also to keep the wound dry. "When it became absolutely necessary the sides of a wound might be sewed without, however, touching the nerve itself. . . . The ends of a disunited nerve shall be brought together by pressure upon the surrounding tissue only." He recommended massage with a special oil of his own formula if the nerve ever did get entangled in the scar and was painful.

In his septic wounds, he threw overboard the theory which was then and later called that of "laudable pus," and used little cushions soaked in warm wine to clean them, then dried them thoroughly. Sometimes he used an "attractive smelling cleansing desiccant applied by a suitable dressing which the master could make very well." Hugo constantly admonished that wounds could not be healed by either incantation or magic powders nor by cauterization with heated stones as was done in many places.

He apparently recognized "septicemia" secondary to infected wounds, stating that when the virus escaped from the wound into the interior, then a warm decoction of roses and various other substances was to be given internally. But the wound was to be continuously treated according to his method despite this escape of virus, and he remarked that if it had been treated correctly the virus could not have escaped into the interior.

That he was able, one can hardly doubt. The description of his method of reduction of fractures by first immersing the patient in a hot bath thereby relaxing all involved structures, then slowly and carefully teas-

20 De apoſtemate mamillarum,& virgæ.
21 De ſcliroſi.
22 De tumore.
23 De puſtulis albis quaſi puncta, quæ apparẽt ſub naſo: & ſuper pomis maxillarum.
24 De ſcroffulis.
25 De glandulis,& nodis.
26 De teſtudine.
27 De nodis ſiue teſtudinibus contingentibus in capite: & dicuntur cornua.
28 De nodis ſiue lupus quæ naſcuntur in palpebris oculorum.
29 De bubone.
30 De bocio.
31 De napta.
32 De inflatiõe ſiue pinguedine quæ apparet in mamillis quorundam hominum.
33 De hydropiſi.
34 De omni eminentia et ruptura: quæ accidit in ſiphac ventris.
35 De hernia inteſtinali.
36 De hernia aquoſa, ventoſa, et carnoſa.
37 De apoſtematibus teſticulorum.
38 De verrucis,& porris accidentibus in virga, uel in alia parte corporis, et de clauis, et formicis.
39 De clauis ſiue callis.
40 De cura formicæ cum ferro.
41 De hæmorrhoidibus.
42 De fiſtulis in ano.
43 De ficu facto in ano.
44 De lapide veſicæ & renum.
45 De cauterijs & iuuamento ipſorum: & quomodo ſint in quibuſdam ægritudinibus faciẽda.
46 De combuſtione ignis, aquæ, & olei: vel aliquo huiuſmodi.
47 De ſcabie,& pruritu.
48 De puſtulis faciei.
49 De malo mortuo.
50 De impetigine,& ſerpigine.
51 De gutta roſacea.
52 De pannaritio.
53 De morphea.
54 De lentiginibus, panno, rugis, liuore, nigredine.
55 De lepra.
56 De tuberibus.

Fig. 2. A list of varying subjects published by Hugo and Theodorich, evidence of their versatility.

ing or coaxing the fragments into alignment, is brilliant. In fractures of ribs he used gentle massage and compression much in the manner in which we do artificial respiration, pressing inwardly where necessary with one hand and massaging lightly somewhere near with the other until he had obtained that degree of approximation of fragments he desired. In similar manner he reduced dislocations.

A description by his son of such a fracture reduction is as follows, "The master Sir Hugo, led the patient into a warm bath where he was instructed to lie down. Dipping his hands into first turpentine, then honey and then pitch, Hugo laid his hands on the place where there was the weakness, pressed inwardly then lifted his hands suddenly. This procedure was repeated quite often until the ribs were brought back into a normal position after which a dressing of pitch and tar was made to hold this position." In the matter of splints for fractures, he did not recommend them or use them much. He preferred thickened dressings which could be moulded by hand rather than those made of "timbers" as he described them.

Compound fractures he described in detail. Their treatment was to consist of the application of both his methods. The first, reduction of the fracture itself, the second, his usual method of treatment of any and all wounds.

That he was humane in his work can be judged by his descriptions of his "spongia soporifera" to induce narcosis in those patients where pain could not be avoided. Although there is much evidence that there were many varied procedures for producing some degree of narcosis and insensibility to pain by surgeons in much earlier times, Hugo stressed the use of inhalations of varied and secret drugs as anesthetics. The composition of his "spongia somniferens" was known only to him. By many it is presumed that this method of narcosis was originated by him. Whether this is true or not we do not know, but at any rate he popularized its use.

His therapeutic armamentarium is evidence of his versatility. He himself made many "collyria," prescribing them for redness and inflammation of the eyes. A "holy salve" which was a "cure all" in the healing of wounds, was a secret formula. Another salve contained mercury which he used in skin diseases and it is to him that credit must be given for the first description of the salivation and gum changes produced by the prolonged use of mercury. Others of his salves contained arsenic and were used as cauterizing agents in fissures and wounds. These were called "encaustrum" and likewise were a secret composition of his own.

He wrote of using a "coagulum leporis" which historians relate was not new to him or his time, having been used in earlier days. It consisted merely of the coagulated blood of hares. If only these historians had recorded in what conditions he used this coagulated rabbits' blood, particularly if in hemorrhage, what an interesting point that would make. He did describe extensive bleeding from wounds, but no technique of treatment other than his usual method of closure.

An anodyne powder is described by his son as being a part of the after treatment of all his severe cases, but its formula is not mentioned. It was called only a "wound drink," dissolved in wine.

Like any good surgeon he stressed the after care of his patients and paid particular attention to their diet. "Pigmenta," his wound drinks were called because they were designed to produce blood and flesh. He was a very pious individual and instructed his patients to say a prayer whenever they partook of these drinks, which was several times a day. He even designated certain prayers which should be said at the various hours. These wound drinks were mainly highly concentrated beef or chicken broths.

As to meats, he declared that capons, partridges, pheasants and small birds with fine beaks, were of exceptional quality to produce blood and sinew. Meat of suckling

goats and of castrated spring cattle was also very fine. Chicken eggs were to be eaten daily, cooked in any manner except sodden or fried.

Paramount, however, was the instruction that the best wine obtainable, not requiring the addition of water, should be taken for regaining strength.

That he took part in the civic life about him is evidenced by the fact that in 1214 he was appointed city physician to the town of Bologna. In 1218 he was persuaded to join the Bolognese contingent to the Crusade, returning in 1221 to take up once again his duties as city physician. In this post he is credited with drawing up the first legal sanitary measures and rules regarding water, waste disposal, etc., as a modern health officer would be expected to do.

It is rather singular that a great name and presumably a great surgeon should have singled out the name of Hugo of Lucca upon which to vent his vilification and abuse. Guy de Chavliac swore to the high heavens that not only Hugo but also his son Theodorich, were no more than charlatans and quacks of the highest order, and accused them of plagiarizing the older Greek masters, then claiming for themselves that all they propounded was original.

This anger and abuse was probably incited by the fact that Guy de Chaviliac was the great exponent in his time of the theory of "laudable pus," while Hugo and his son proclaimed vehemently that there was no such thing. "It is not necessary, as many supposedly great minds have taught and are teaching, that pus must be generated in wounds. To practice such a method is only to hinder nature and to prevent good approximation and healing of wounds."

Yet we find in the works of Guy de Chaviliac, who accuses them of plagiarism, the identical descriptions word for word as written by Theodorich at the direction of Hugo, and even the illustrations to the chapters of his great opus, his surgery, are copies of those from the works of Hugo.

A perusal of the life and work of the two individuals makes one ponder whether one shouted the loudest and had the best publicity while the other went on unspectacularly producing results. At any rate, history seems to have given the verdict of popularity to Guy de Chavliac, whether he deserved it or not.

The School of Bologna itself, independent of its famed faculty member, was instrumental in contributing a milestone in the progress of medical science and it came about in an interesting manner. First, in speaking of these medieval universities certain things must be kept in mind in order that a better picture may be obtained. In Bologna as at Salerno, Monte Cassino, and other centers, the actual popularity and success of the institution was dependent entirely upon the fame and learning of its faculty. It was because of the quality of scolarship that students flocked from England, Germany, France, and other countries to any one particular center. At the very peak or height of its affluence the school of Bologna had a registration of 10,000, speaking volumes for its faculty. Its fame rested upon its school of medicine and surgery and its school of law.

One day in the streets of Bologna a man dropped dead from no apparent cause. The medical faculty being unable to give any satisfactory explanation other than that it was probably due to some disease of the heart, the law faculty insisted that a postmortem examination of the heart should be made and this was done.

It is rather certain that human dissection was practiced in old Grecian and Roman times, but it was done secretly and no actual record ever was made. There is an old medical manuscript in the Bodleian Library which contains a drawing of a dissection scene, using a human body. This manuscript is presumed to have been written about the year 1300 A.D. The Church had formally prohibited human dissection because it had become the practice of the Crusaders to cut up the bodies of those who died and boil the pieces in order

to separate the flesh from the bones, since it was more feasible to repatriate the bones of those who died in distant countries. The bones might then be buried in the home parish. Transportation facilities had to be considered. It was easier to transport a few bones than a whole body, but the Church forbade this practice.

When the law faculty considered this case of sudden and unexplained death, they demanded at least a post-mortem examination of the heart. By so doing they broke the fetters of custom which had entwined medical anatomy for ages and unknowingly laid the foundation for the school of brilliant anatomists who were to follow and who were to base their descriptions and drawings upon the study of actual human bones and flesh. This was definitely a milestone in medical progress, and to the University of Bologna must be given the credit first for the establishment of post-mortems in the study of disease, and second, for the brilliant strides in anatomy which took place from that time on.

As to the writings and works which Hugo left to posterity, as stated previously, there is some degree of uncertainty as to whether much has disappeared or whether he really wrote little. He lived to a very old age, reckoned by biographers to have been in the vicinity of one hundred years. He had four sons, all of whom were physicians, but only one, Theodorich, attained any degree of fame. To him Hugo entrusted all of his secret formulae and methods of therapy, and it is recorded that he did not impose the oath of secrecy upon this son as was the custom of the times. This custom originated with earlier physicians and surgeons in order to protect the formulae and methods they used for the benefit of their families when they died, that they might continue to derive remuneration from them. If there was a son who elected to become a physician all information was given to him and he was sworn to secrecy. If there was no son and an assistant had proved of sufficient loyalty and merit, then the information was his on the same basis.

It is probable that Hugo wrote little, leaving this part of his work to his son. A "Cyrurgia" was published in Venice in 1497, and is presumed to consist of the combined manuscripts of Theodorich and Hugo. It is this work which Guy de Chavliac later incorporated into his own. Later editions of it were published in Venice, in 1499 and 1500. Two treatises which were definitely known to exist in manuscript from, a "De Sublimatione Arsenici," and a "De Aluminibus et Salibus" are presumably lost.

Copies in Spanish and Italian exist of a work entitled "Practica Equorum" dealing with veterinary medicine. It is supposed that the material in this is entirely Theodorich's.

Only the "Cyrurgia" remains to Hugo's memory. He compiled it before the middle of the thirteenth century and dedicated it to the bishop of Valencia. This fact may account for its later Spanish translation. From this Spanish translation, one was made into Hebrew.

A small manuscript dealing with the manufacture of wines and with their use in disease was known to have existed but its whereabouts today is unknown. If found, it would probably be the first treatise on wine, antedating Andre De Villanouas' "De Vinis" by some years.

Hugo should be classed among that large group of physicians and surgeons who have stood unflinchingly by principles in which they believed. His place in medical history is secure because of his intensely practical aptitude, his ability as a surgeon, as a teacher of medicine, and as the real founder of what could be called the Italian school of surgery which had originated with him at Bologna in the middle of the thirteenth century.

SPECIAL MONOGRAPH

Surgery of the Gall-Bladder and Extrahepatic Bile Ducts

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SURGERY OF THE GALL-BLADDER AND EXTRAHEPATIC BILE DUCTS

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INTRODUCTION

SURGERY of the gall-bladder and extrahepatic bile ducts represents one of the most common fields for surgical practice. There can be little doubt that the need for surgical procedures in this field is increasing because of the extension of life, whereby more persons reach the age when cholelithiasis is both likely to occur and prone to produce its characteristic symptomatology. In 1850 persons over 65 years of age comprised 2.6 per cent of our population; today they constitute 6.4 per cent; and in 1980, according to present progression, they will have reached 14.4 per cent. The surgery of the biliary tract, therefore, will become an even more important consideration for the coming generation of surgeons.[19]

This discussion is planned to give a practical approach to the surgical treatment of the common lesions of the gall-bladder and extrahepatic bile ducts and, therefore, our primary concern must be the removal of an acutely or chronically inflamed gall-bladder usually associated with calculi. But since approximately one-fifth of the patients requiring cholecystectomy have calculi in the extrahepatic biliary ducts, procedures involving the common duct become of equal importance. Any surgeon who dares subject his patient to cholecystectomy must be qualified to recognize and carry out safely the procedures best designed to remove or correct pathologic changes involving the extrahepatic ducts as well. In addition, a small miscellaneous group of conditions of less frequent occurrence will be presented, including congenital anomalies, division of the duct or traumatic stricture, and compression of the ducts by intrinsic or extrinsic tumors. This treatise will not cover primary disorders of the liver unless extension of the primary condition involves the extrahepatic biliary system. Thus, abscess, tumors, and cysts of the liver will not be referred to.

CONGENITAL ANOMALIES

It is not out of place in a treatise of this kind to call to attention the congenital lesions since some may persist to later life and thus unhappily surprise the unwary surgeon. The common congenital anomalies are of the gall-bladder and of the common duct.

A double gall-bladder has been reported twenty-eight times. This accessory bladder may be contiguous to the normal organ, have an opening directly into the gall-bladder or into the normally formed gall-bladder's cystic duct, or the accessory gall-bladder may be at some distance from the normally situated viscus and empty into a totally different radicle of the hepatic duct.

Bilobed gall-bladders occur and gall-bladders with pouches much like diverticula. Such accessory gall-bladders may cause no symptoms until they become the seat of either inflammation or stone. Should such an accessory gall-bladder be on a freely movable pedicle, torsion may occur and an abrupt clinical syndrome be brought to the surface. The clinical picture of such torsion is characterized by abrupt and continuous pain of great severity set aside from biliary colic by its steady persistence and failure to show periodicity and remittance. Nausea and vomiting usually occur.

Anomaly of the common bile duct may take on several forms, the commonest clinical syndrome being that known as cystic or idiopathic dilatation of the common bile duct. This may be due to failure of the duct to develop, stenosis at the papilla, congenital weakness of the duct wall, the abnormal course of the duct, or even valve-like obstruction, such as occurs on rare occasions in the prostatic urethra. Apparently cystic dilation of the bile duct is a well established clinical syndrome appreciated by those surgeons familiar with the surgery of childhood. The prominent findings are tumor, jaundice, and pain. Experience has shown that it is unwise to search for the cause of this idiopathic dilation of the common duct and wise to perform at once an anastomosis usually between the dilated duct and the duodenum. In a report by Gross of fifty-two cases, the mortality of surgical treatment for the whole group was 69 per cent, but in those treated by anastomosis between the biliary tract and intestine the mortality was only 9 per cent.

Other anomalies of the common duct occur. Boyden reports sixteen cases of congenital doubling and five cases of abnormal insertion of the common duct. Ladd has called attention to complete

atresia of the duct below the insertion of the cystic duct and also to stenoses occurring in the hepatic ductile system. As a matter of interest the common duct may be entirely absent and its failure of development may extend well up into the hepatic radicles. What is important in this consideration is that the surgeon recognize the fact that anomalies occur in order that he may be forewarned in atypical cases.

CHRONIC CHOLECYSTITIS WITH AND WITHOUT STONE

An analysis of the symptoms of the patients in the Peter Bent Brigham Hospital subjected to surgery for chronic cholecystitis with or without cholelithiasis has been made in an effort to throw some light on the symptoms of those subjected to cholecystectomy. Our records show that approximately 90 per cent have a history of biliary colic and pain of marked severity. This indicates that, in general, we have declined to operate upon patients who have only vague indigestion as the major complaint because it has been generally demonstrated that the results do not justify the risk.[7,11] Two-thirds of our patients with chronic cholecystitis and cholelithiasis have pain in the right upper quadrant referred to the back. Not more than one-third have at any time complained of epigastric distress; in contrast, patients with acute cholecystitis or common duct stone show a much higher instance of epigastric distress. Approximately 10 per cent of our patients have pain in the left upper quadrant or left infrascapular region instead of the customary right upper quadrant, due, some believe, to an associated pancreatitis. Rehfuss and Nelson report a similar figure. We are unable from experimental observations to explain to our satisfaction the mechanism of left upper quadrant pain.[27]

If vomiting is spontaneous and pronounced when associated with gallstones, we believe that a calculus is located within the cystic or common ducts. This supposition is borne out by an analysis of our cases. Vomiting was found to occur in less than half the cases of chronic cholecystitis in which the patients gave no history of jaundice and in which no stone was found in the ampulla or the cystic or common ducts. This finding agrees with the views of those who believe that a patient with cholelithiasis uncomplicated by duct obstruction may have nausea and induced vomiting but not involuntary vomiting.

A high percentage (94 per cent) of the patients subjected to cholecystectomy at the Peter Bent Brigham Hospital have a proved calculus at the time of operation. This high incidence of calculus no doubt results in part from our rigid selection of patients, who must have pronounced gall-bladder symptoms, such as colic, etc., as previously described, and in part from our custom of submitting every patient to intravenous cholecystography before cholecystectomy unless calculi are positively shown by the oral method. A poorly functioning gall-bladder or failure of the gall-bladder to be visualized by the oral test is not sufficient evidence, in our opinion, to warrant cholecystectomy unless the clinical symptoms are overwhelmingly in favor of disease of the biliary system. It has been shown by Sosman that approximately 30 per cent of the gall-bladders which appear to be abnormal with oral administration of dye, single bottle technique, can be visualized by giving the dye intravenously.

The following technique is followed for the intravenous administration of tetraiodophenolphthalein. A standard dose of 2.5 gm. of tetraiodophenolphthalein is given to all patients weighing over 50 Kg. (110 pounds); patients weighing less receive 40 mg. of the dye per Kg. of body weight. The dye is diluted in 30 c.c. of distilled water; autoclaved for fifteen minutes; diluted with 100 c.c. of sterile saline; and given intravenously about 11 P.M. No food is allowed until after the *x*-ray, but water is permitted as desired. A soapsuds enema is given. Roentgenograms are taken in the morning some ten hours after administration of the dye.

It is interesting to note that only about one-third of the patients seen in the Roentgenological Department showing pathology in the gall-bladder by the dye test are subsequently submitted to surgery. This does not mean necessarily that surgery is not recommended, but that certainly a large percentage of these patients not coming to operation must get along comfortably without surgical intervention.

With such rigid selection of cases for surgery, the failures from improper interpretation of symptoms from the biliary tree or from confusion with an associated arthritis of the spine or pathology of the right kidney, duodenal ulcer, or other factors are infrequent, moreover, operation is limited to the group of patients that statistics show will receive the greatest benefit from surgery.

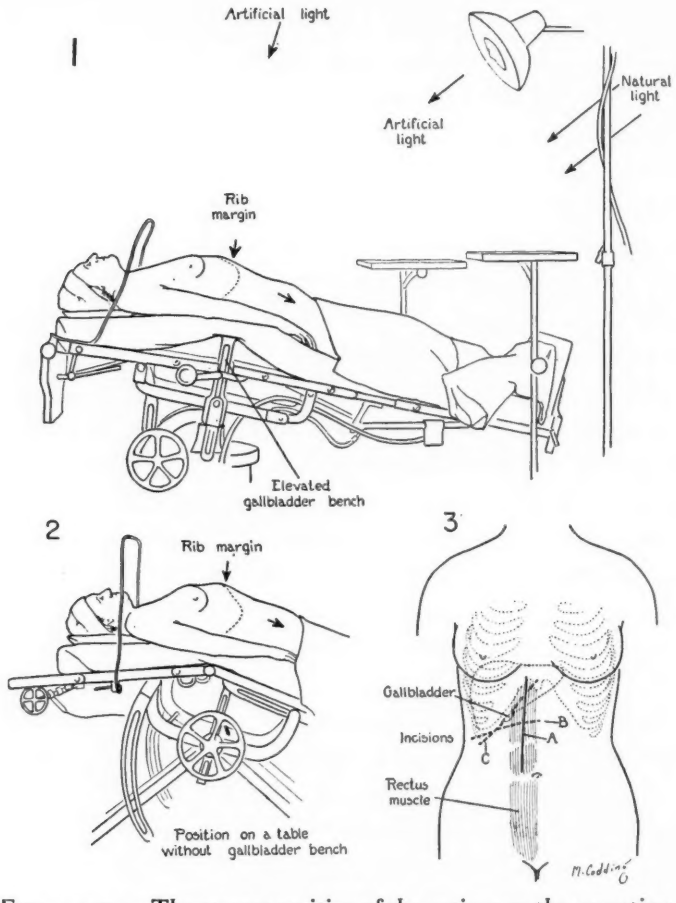
Since the patient with chronic cholecystitis can usually have the operation at a time of election, he should receive adequate

preoperative preparation. Obese persons with symptoms severe enough to warrant cholecystectomy should be held rigidly to a low caloric diet until the weight is substantially reduced, because mortality in the obese is distressingly high. Otherwise a high carbohydrate intake is provided, and our patients are urged to eat candy in any form, cereals, and similar foods for several days previous to operation. In addition, it is desirable to force fluids for the twenty-four hours before operation. The high incidence of pulmonary complications following any upper abdominal surgery makes it imperative that the patient be free of chronic cough and respiratory infection so far as this is possible. As a check on the respiratory condition our patients have vital capacity determined. This, if abnormally low, calls for cancellation of the surgical procedure until the cause and possible correction of this low vital capacity can be determined. Phlebitis or other infection about the lower extremities must be cleared up before operation because of the all too frequent occurrence of embolism in association with gall-bladder operations. For this reason the veins of the lower leg are not used if difficulty is experienced in finding the veins of the cubital fossa when administering solutions or dye. Since many patients have difficulty in voiding after any type of operation, each patient during the preoperative days should familiarize himself with the use of the bedpan, especially for urination.

The condition of the patient and the custom of the surgeon govern the choice of anesthesia, but adequate relaxation of muscles simplifies the operation. In elderly or debilitated patients, local anesthesia (novocaine, 1 per cent, without adrenalin) may be used with satisfaction. However, the majority of our patients receive avertin supplemented by ether; if the patient is jaundiced or if there is evidence of liver damage, avertin is not given.

Cholecystectomy, Retrograde Method. The importance of placing the patient on the operating table in the position most advantageous for later exposure and for obtaining maximum benefit from natural and artificial light cannot be overemphasized. The patient is hyperextended at the costal margin either by elevating the gall-bladder rest (Fig. 1) or by breaking the operating table. (Fig. 2.) The entire table is tilted until the patient is in a semi-erect position. With the patient in position the liver and gall-bladder tend to drop below the costal margin and at the same time the intestines fall away from the upper abdomen, giving natural retraction for the

field of operation. With side-lighting in the operating room the operating table is turned so that the feet of the patient point toward the maximum point of natural light. This is augmented by overhead



FIGS. 1 AND 2. The correct position of the patient on the operating table is shown.

FIG. 3. The common types of incisions for cholecystectomy are indicated.

artificial light, preferably supplemented by a portable spotlight which can be shifted to meet the demands and problems of the operation as it progresses. (Fig. 1.) Two instrument tables of the Mayo type are brought close to the operating field over the lower extremities of the patient.

After the surgeon has assured himself that the position and lighting are entirely satisfactory, the skin is prepared with the antiseptic of choice. We prefer to use alternately alcohol (70 per cent

ethyl) and zephiran (1:1000 aqueous solution).[9] The site of incision is then scratched before the field is entirely covered with sterile towels and drapes. Although various types of incision (A, B, and C)

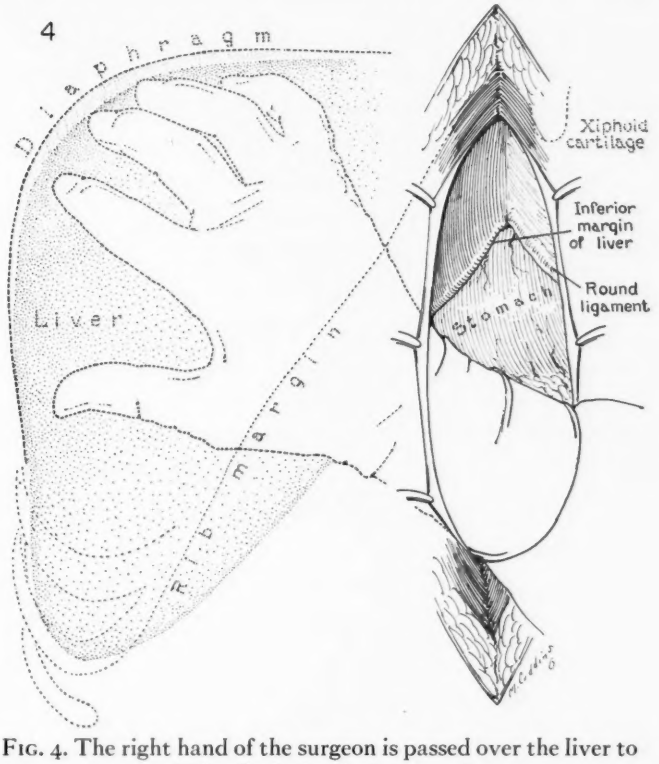


FIG. 4. The right hand of the surgeon is passed over the liver to aid in displacing it downward.

are shown, we usually employ a vertical, high right rectus incision (A), as shown in Figure 3. This is outlined starting over the costal margin just to the right of the ensiform process and continuing downward to the umbilicus or below depending upon the size of the patient. A liberal skin incision is always made to make certain that it is longer than the peritoneal incision. After the incision has been outlined with the back of a scalpel, the patient is draped with towels so that all skin is covered except the outline of the incision itself. The final drapes are applied.

When the incision has been deepened to the rectus sheath and all bleeding points have been tied, the fat is protected from contamination by towels or pads moistened with warm, isotonic salt solution. The rectus sheath is incised in its midportion or toward the midline, and the muscle fibers are split in a parallel fashion.

Some surgeons prefer to reflect the entire rectus muscle laterally to avoid injury to the motor nerves. Active bleeders are ligated at each tendinous striation. If the rectus muscle has been divided in its midportion, an effort should be made to retract the nerves downward or upward to avoid their permanent damage. The transversalis fascia and peritoneum are then opened, beginning to the right of the xiphoid and continuing to the umbilicus. At this point the underlying falciform and round ligaments are encountered and retracted medially, following which the transversalis fascia and peritoneum are fixed with curved half-length clamps to the gauze packs which already cover the subcutaneous fatty tissue. The incision is carried upward to the region of the xiphoid, for in our experience the pleural cavity has never been opened when this approach for cholecystectomy was used. (Fig. 4.) An incision properly made exposes the anterior surface of the liver, making possible an easier presentation of liver and gall-bladder. If the incision is started at the costal margin over the region of the gall-bladder instead of near the midline adjacent to the xiphoid, the procedure is much more difficult.

After the peritoneal cavity has been opened, the gloved hand moistened with warm salt solution explores the abdominal cavity unless there is acute suppurative infection involving the gall-bladder. The stomach and pylorus especially are inspected and palpated. Following the general abdominal exploration, the surgeon passes his right hand up over the dome of the liver to allow displacement of air between the diaphragm and liver and to aid in dislodging the liver downward. (Fig. 4.) When assistance is limited, a self-retaining retractor of the Balfour type may be used advantageously or an ordinary retractor of the Halsted type may be used on the right side to retract the costal margin. A half-length clamp is applied to the round ligament and another to the fundus of the gall-bladder. (Fig. 5.) Some surgeons prefer to divide the round ligament between half-length clamps; usually, however, this is unnecessary. Traction is then maintained downward by the clamps on the fundus of the gall-bladder and on the round ligament. This traction is exaggerated with each inspiration as the liver is projected downward. (Fig. 5.) After the liver has been pulled downward to the limit of easy traction, the half-length clamps are then pulled toward the costal margin to present the under surface of the liver and gall-bladder. (Fig. 6.) These clamps are then held by an assistant, while the surgeon prepares to wall off the field. Should the

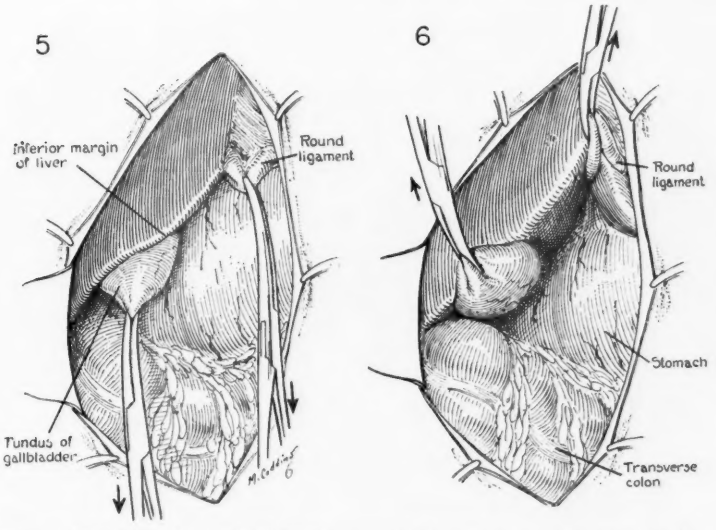


FIG. 5. Traction is applied to the round ligament and fundus of the gall-bladder with half-length clamps to pull the liver downward.

FIG. 6. Traction on the half-length clamps applied to the round ligament and gall-bladder is directed outward and upward to expose the under surface of the liver and gall-bladder.

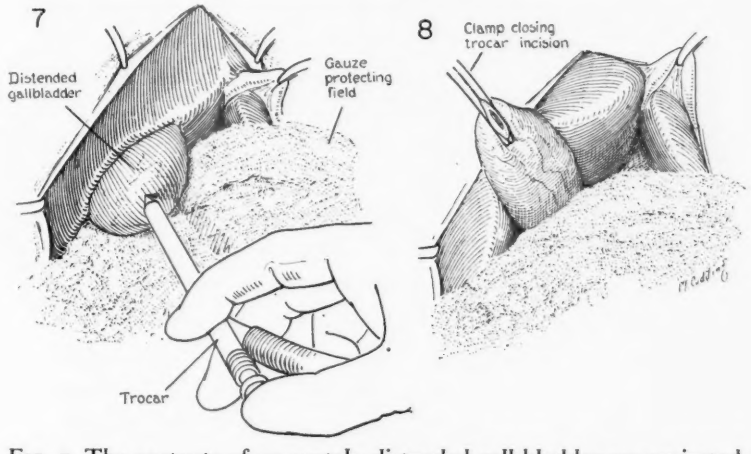


FIG. 7. The contents of an acutely distended gall-bladder are aspirated with a trocar before the application of clamps to the gall-bladder.

FIG. 8. A curved half-length clamp is applied to the fundus of the collapsed gall-bladder to seal the trocar opening. The concavity of the clamp is toward the costal margin.

gall-bladder be acutely inflamed and distended, it may be necessary to aspirate some of its contents through a trocar before the half-length clamp is applied to the fundus, lest small stones be forced into the cystic and common ducts. (Figs. 7 and 8.)

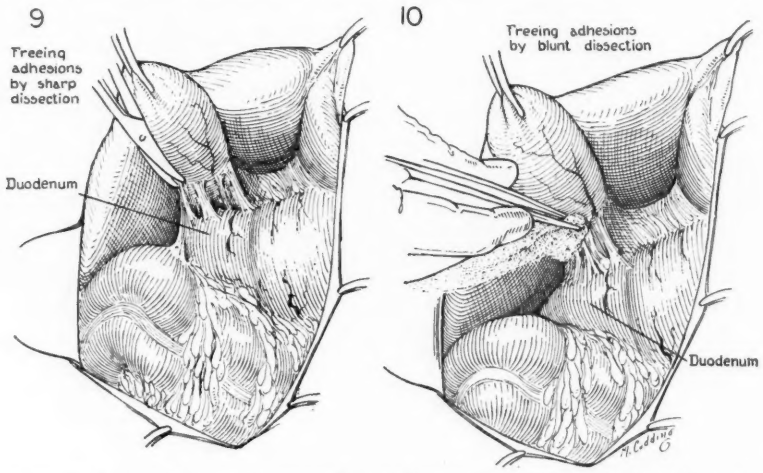


FIG. 9. Any adhesions between the under surface of the gall-bladder and adjacent structures are divided by sharp dissection.
FIG. 10. Following sharp dissection the region of the ampulla may be further exposed by gauze dissection.

Adhesions between the under surface of the gall-bladder and omentum are frequently found drawing the duodenum or transverse colon up into the region of the ampulla. These adhesions are divided with curved scissors until an avascular cleavage plane can be developed adjacent to the wall of the gall-bladder. (Fig. 9.) After the initial incision is made, it is usually possible to brush these adhesions away with gauze sponges held in forceps, thereby presenting a smooth gall-bladder wall. (Fig. 10.) Once the gall-bladder is freed from its adhesions, it can be lifted upward, thus affording better exposure. In order that the neighboring structures may be packed away with moist gauze pads, the left hand of the surgeon is inserted into the wound palm down to direct the gauze pads downward as they are introduced with long, smooth forceps. (Fig. 11.) The stomach and transverse colon are packed away, and a final gauze pack is inserted into the region of the foramen of Winslow. (Fig. 12.) The gauze pads are held in position either by a wide, smooth retractor along the lower end of the field (Fig. 13) or preferably by the left hand of the first assistant, who with fingers slightly flexed and spread apart maintains moderate downward and slightly upward

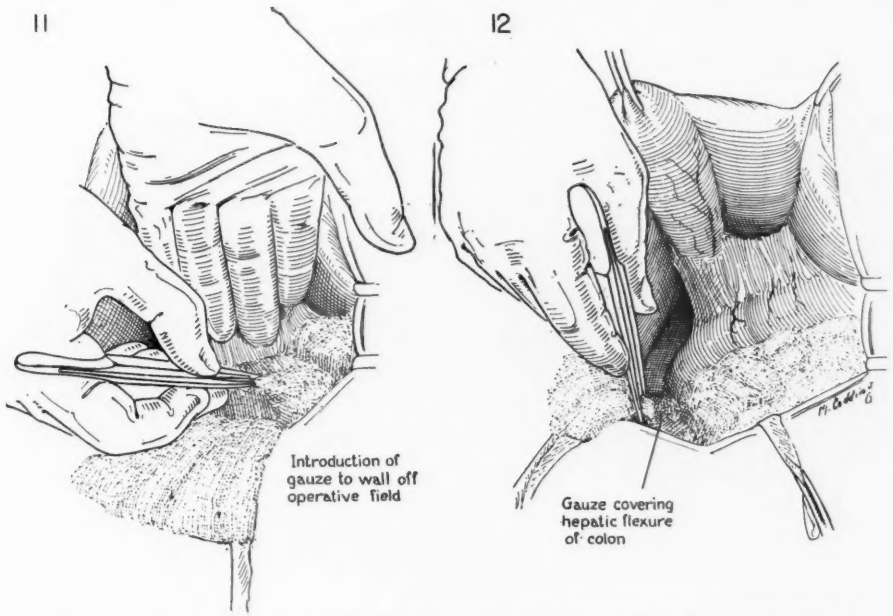


FIG. 11. Two gauze pads are necessary to pack off the stomach and transverse colon.
FIG. 12. A gauze pack is placed to wall off the right lumbar gutter.

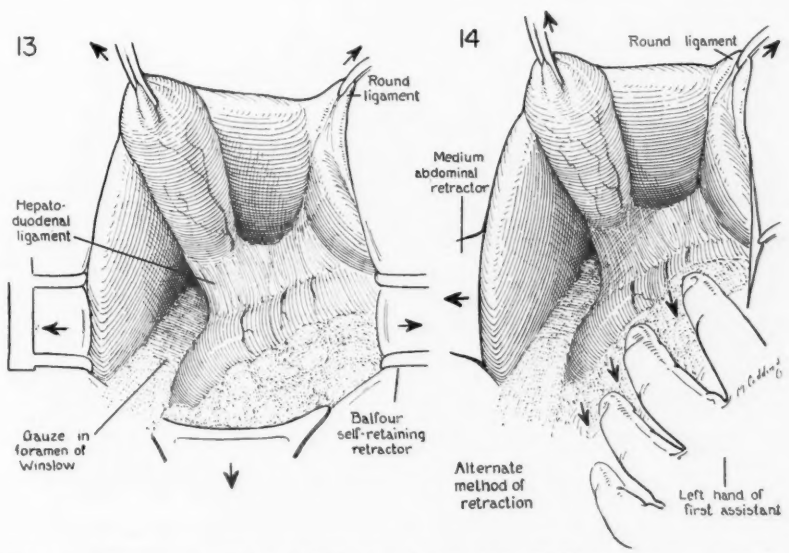
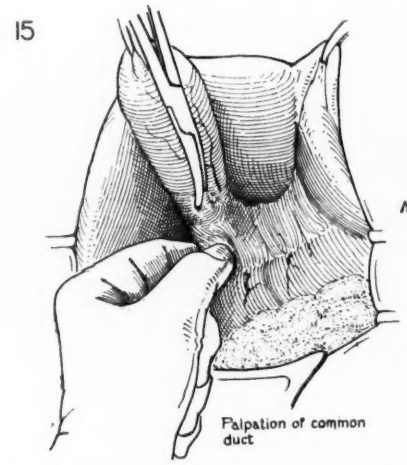


FIG. 13. Exposure is maintained by a self-retaining Balfour retractor supplemented by a Halsted retractor at the lower angle of the wound.
FIG. 14. The alternate method of retraction is obtained by a lateral abdominal retractor and the left hand of the first assistant.



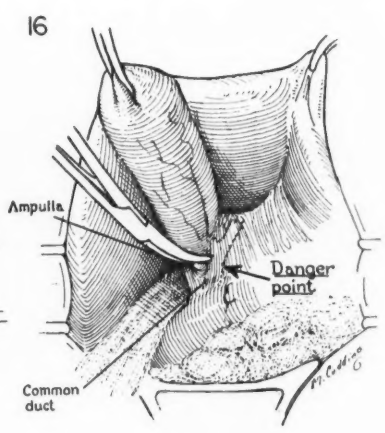
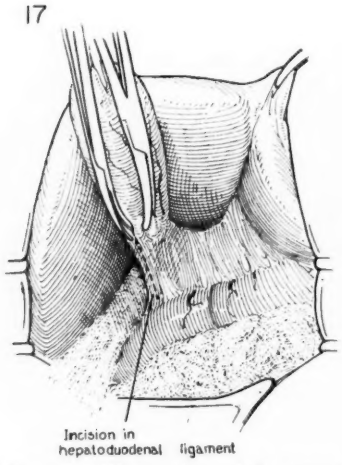


FIG. 15. The cystic and common ducts are palpated for calculi. Additional traction is applied to the gall-bladder by a curved half-length clamp placed above the ampulla.

FIG. 16. A curved half-length clamp must never be applied low in the region of the ampulla of the gall-bladder because of the danger of including part or all of the common duct.



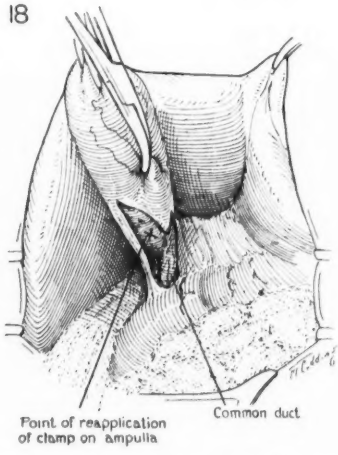


FIG. 17. The region of the ampulla and cystic duct is exposed by an incision in the lateral margin of the hepatoduodenal ligament. This may be made with scalpel or long curved scissors.

FIG. 18. The incision in the hepatoduodenal ligament is carried to the upper side of the ampulla and exposes the common duct. A curved half-length clamp may now be safely applied to the ampulla at the location marked x.

pressure, better defining the region of the gastrohepatic ligament. (Fig. 14.)

After the field has been adequately walled off, the surgeon introduces his index finger into the foramen of Winslow and with

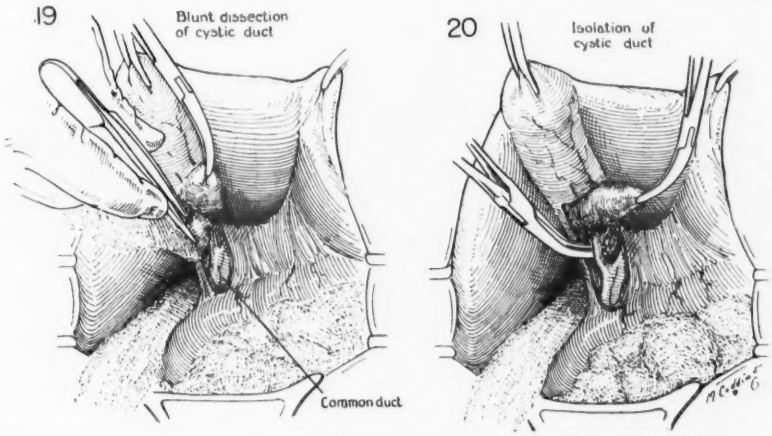


FIG. 19. Traction is maintained on the ampulla of the gall-bladder while the cystic duct is dissected by blunt dissection.

FIG. 20. A long Lower clamp is used to isolate the cystic duct from adjacent structures.

finger and thumb thoroughly palpates the region of the common duct for evidence of calculi as well as for thickening of the head of the pancreas. (Fig. 15.) A half-length clamp grasps the under surface of the gall-bladder to maintain upward traction. The early placement of clamps in the region of the ampulla is one of the frequent causes of accidental injury to the common duct. This is especially true when the gall-bladder is acutely distended, because the ampulla may run parallel to the common duct for a considerable distance. If the clamp is applied low and blindly, part or all of the common duct may be included in it. (Fig. 16.) For this reason it is always advisable to divide the peritoneal attachment in the region of the ampulla rather high on the gall-bladder, extend the incision carefully downward to the hepatoduodenal ligament, and by means of blunt dissection free up the region of the ampulla. (Fig. 17.) The peritoneum is usually incised with long Metzenbaum dissecting scissors. An incision is likewise made in the peritoneum on the upper side of the ampulla and cystic duct. (Fig. 18.) By blunt dissection the gall-bladder wall is followed down to the region of the cystic duct. Dissection is gingerly carried out in this region because of possible damage to the cystic artery. After the peritoneum has been incised

and the ampulla of the gall-bladder has been more clearly defined, the half-length clamp may be reapplied lower on the ampulla in the location, x. (Fig. 18.)

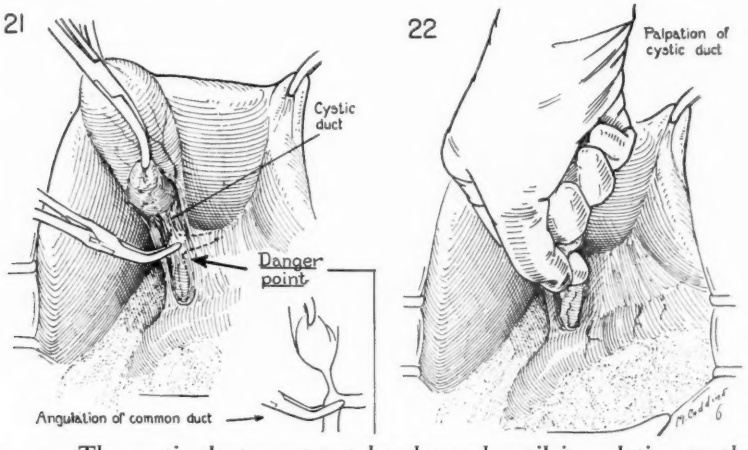


FIG. 21. The cystic duct must not be clamped until its relation to the common duct is visualized. Excessive traction on the ampulla angulating the common duct may be responsible for accidental clamping of the latter structure.

FIG. 22. The cystic duct is palpated carefully for calculi before clamps are applied.

With traction maintained on the ampulla, the cystic duct is defined by means of gauze dissection. (Fig. 19.) A long Lower clamp is then passed behind the cystic duct and moved to and fro, its blades cautiously separated, until the cystic duct is well isolated from the common duct. (Fig. 20.) Whenever possible, unless occluded by a severe degree of inflammation, the cystic duct and cystic artery should be isolated separately to permit individual ligation. Some surgeons prefer to isolate and ligate the cystic artery before ligating the cystic duct; however, it is our custom to isolate and divide the cystic duct first. Under no circumstances should the surgeon blindly apply a right-angle clamp to the supposed region of the cystic duct in the hope that he can include both in one mass ligature. If the upward retraction on the gall-bladder is marked and the common duct is quite flexible, it is not uncommon to have it angulate acutely upward giving the appearance of a prolonged cystic duct. The surgeon must recognize this possibility and constantly keep this mental image before him to avoid injury to or division of the common duct when the right-angle clamp is applied to the supposed cystic duct. (Fig. 21.) It is advisable, after the

cystic duct has been isolated, for the surgeon to palpate it thoroughly to make certain that no calculi are forced into the common duct by the application of clamps and that none is left in the stump

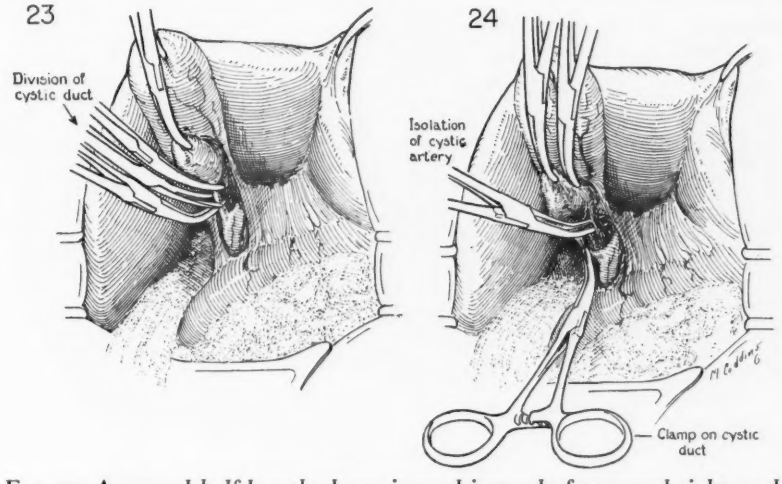


FIG. 23. A curved half-length clamp is used instead of a second right-angle clamp to give sufficient room for division of the cystic duct.
FIG. 24. The long Lower clamp is alternately opened and closed to isolate the cystic artery.

of the cystic duct. (Fig. 22.) Palpation rather than the application of a clamp in an upward and downward motion is the more judicious maneuver because of the danger of crushing small calculi in the cystic duct. Their resultant extrusion into the common duct might offer a possible nucleus for the later complication of common duct stone.

The size of the cystic duct must be carefully noted by the surgeon. If the cystic duct is dilated and it would seem from palpation that the calculi in the gall-bladder could pass easily through it, the surgeon is in duty bound to perform a choledochostomy. Regardless of whether or not the patient is jaundiced or whether he believes from the history that the patient has apparently no indication of a common duct stone, the size of the common duct and the consistency of its wall should be determined in every case in which the gall-bladder is removed. If after palpation of the cystic duct the operator is certain that the common duct is not so angulated as to be included in the clamp and that it need not be explored, a long Lower clamp is applied. (Fig. 23.) Because it is more difficult to divide the duct between two right-angle clamps closely applied, we prefer to place a half-length clamp above the initial right-angle

clamp. The general curvature of the half-length clamp makes it ideally suited for directing the scissors downward at the subsequent division of the cystic duct. Should it seem judicious to explore the

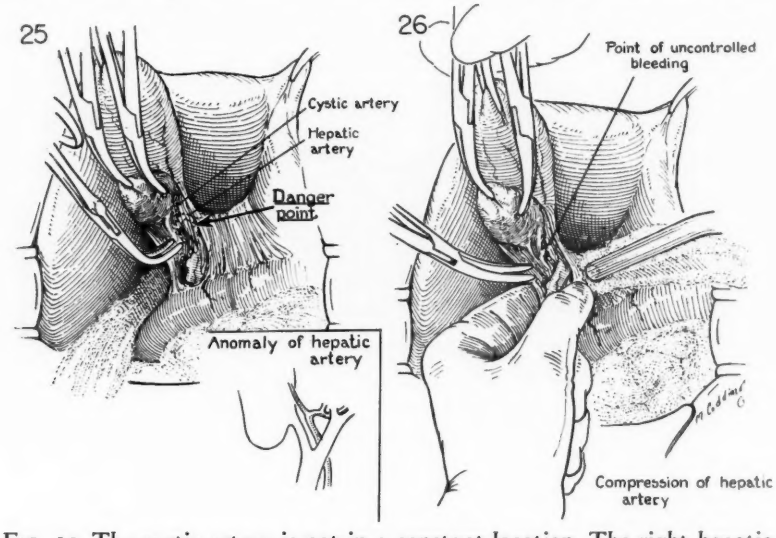


FIG. 25. The cystic artery is not in a constant location. The right hepatic artery may be accidentally ligated with subsequent death of the patient.
FIG. 26. The left hand of the surgeon may be used as a tourniquet to the hepatic artery in cases of uncontrolled bleeding from the cystic artery.

common duct, a right-angle clamp is not applied to the cystic duct nor is it divided until after the common duct has been explored.

If the cystic artery was not divided before the cystic duct, it is now isolated with some surrounding tissue by a clamp similar to that used in isolating the cystic duct. (Fig. 24.) Except in cases of acute cholecystitis, the cystic artery is usually a small vessel. The surgeon should keep in mind the possibility of accessory vessels in the region of the cystic duct and should be familiar with the anomalous positions and routes sometimes taken by the right hepatic artery (Insert, Fig. 25). A clamp should never be blindly applied to this region because occasionally the hepatic artery is in an anomalous location and unwittingly may be clamped and divided with the resultant death of the patient. We have never felt confident in attempting to determine the location of the cystic artery by palpation for pulsation. If the clamp or tie on the cystic artery slips off, resulting in uncontrollable bleeding, the hepatic artery may be compressed by the thumb and index finger of the left hand, temporarily controlling the bleeding; the field may be dried by the assistant; and then as the surgeon releases his compression of the

hepatic artery, a hemostat may be safely applied to the initial bleeding point. (Fig. 26.) If a satisfactory exposure has been obtained and the dissection has been carefully carried out, the region

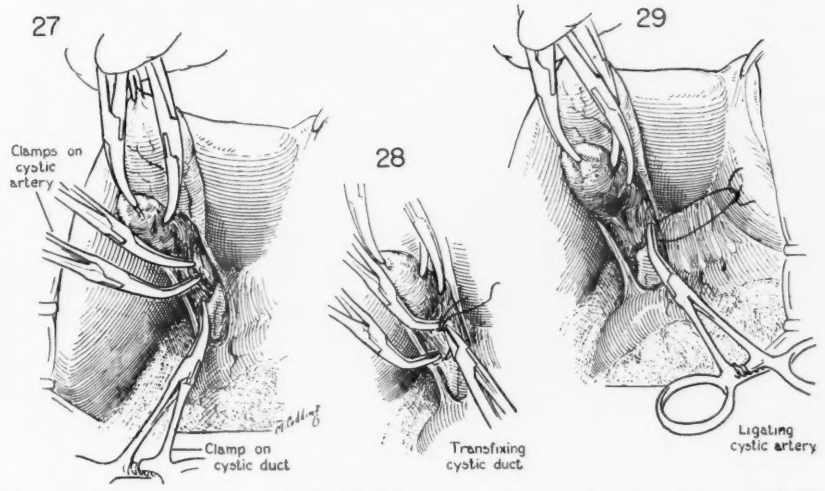


FIG. 27. The cystic artery is divided between a Lower clamp and curved half-length clamp.

FIG. 28. The stump of the cystic duct is ligated with a transfixing suture of fine silk.

FIG. 29. A fine silk ligature is applied to the cystic artery. Note that the cystic artery and cystic duct are not tied en masse.

of the cystic artery can be easily defined. Here again first a Lower clamp and then a half-length clamp is applied, and the artery is divided between them (Fig. 27) and tied with a fine silk ligature. (Fig. 29.) The cystic duct is then tied by passing a French needle through the very edge of the duct, not through its lumen, to permit a transfixing suture of fine silk to be applied. (Fig. 28.) We do not feel that it is necessary to cauterize the stump of the cystic duct after it has been divided. The stumps of cystic artery and cystic duct are each thoroughly inspected, and the common duct is again visualized to make certain that it is not angulated or otherwise interfered with.

After the cystic duct and artery have been tied, removal of the gall-bladder is carried out. About 1 cm. from the liver edge an incision is made with a scalpel into the serosa but not into the lumen of the gall-bladder itself. (Fig. 30.) It is important that the serosa be divided with a scalpel or scissors so that the gall-bladder is not peeled from its bed by traction, thereby leaving raw liver surface, a frequent happening when exposure is difficult in the case of a small, shrunken

gall-bladder. Moreover, it is always advisable, and usually possible, to leave a liver bed which can be peritonealized, thus overcoming the possibility of subsequent bile leakage and the necessity of

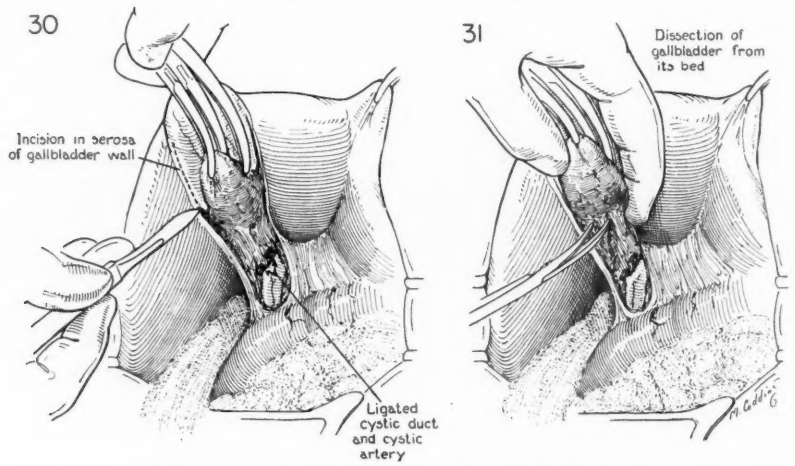

30
Incision in serosa of gallbladder wall
Ligated cystic duct and cystic artery
31
Dissection of gallbladder from its bed

FIG. 30. An incision is made in the serosa of the gall-bladder in preparation for its subsequent enucleation.

FIG. 31. The gall-bladder is grasped in the left hand of the surgeon while it is dissected from its bed by sharp dissection.

inserting a cigarette drain. At this stage the gall-bladder is controlled by the left hand of the surgeon. The clamps applied to the region of the cystic duct and fundus are grasped in the left hand of the surgeon and retracted outward while a cleavage plane is maintained and fine adhesions are divided on the liver side of the gall-bladder. (Fig. 31.) After a cleavage plane has once been developed by sharp dissection, it is frequently possible to enucleate the gall-bladder from its bed in an avascular cleavage plane by inserting the index finger upward between it and the liver bed. (Fig. 32.) The gall-bladder should never be completely removed from its bed, however, but should be retained to serve as a retractor until the peritoneal margins in the deep portions of the wound are approximated. (Fig. 33.) The gall-bladder is finally removed when the last stitch is ready to be inserted at the liver edge. (Fig. 34.) A warm, moist gauze sponge is then laid along the suture line to make certain that there is no oozing and that the field is absolutely dry. It is advisable at this point to lower the gall-bladder bench, if it was used, before proceeding with the closure. If the appendix can be delivered easily into the field, it is removed after the desired procedures on the biliary tract have been completed.

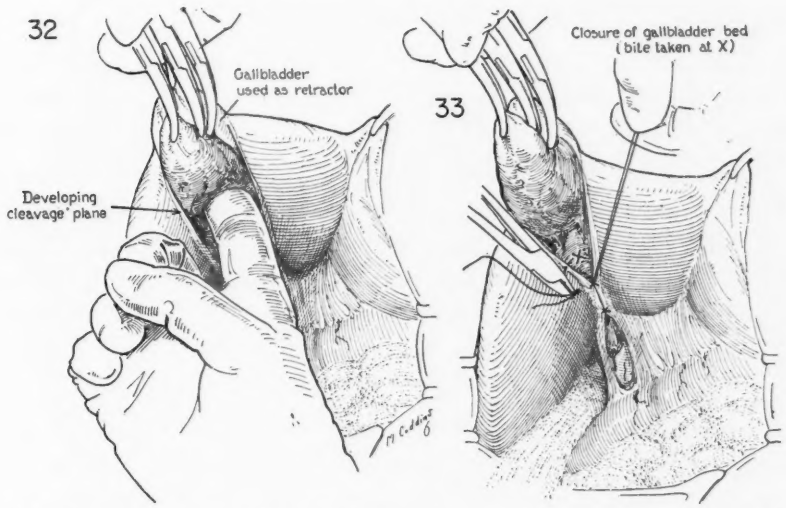


FIG. 32. An alternate method of removing the gall-bladder from its bed by developing a cleavage plane with the index finger. This may be a useful procedure, especially in acute cholecystitis.

FIG. 33. The gall-bladder bed is closed progressively as the gall-bladder is removed.

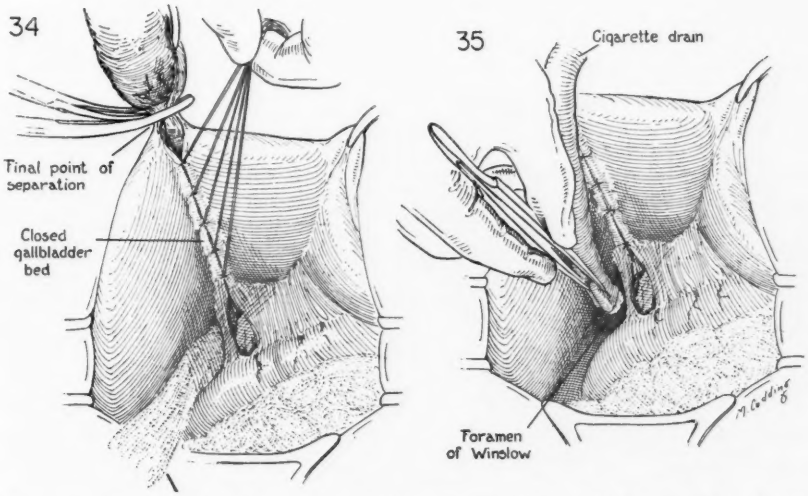


FIG. 34. The gall-bladder is retained as a retractor until its bed has been approximated with interrupted sutures.

FIG. 35. When indicated, a cigarette drain is inserted into the foramen of Winslow or down to the stump of the cystic duct.

Whether or not a cigarette drain should be inserted depends in our estimation on the acuteness of the inflammation in the gall-bladder, the amount of oozing from the field, and the adequacy of the peritonealization of the liver bed, as well as upon how secure and satisfactory the ligation of the cystic duct and cystic artery has been. We tend to insert a cigarette drain in fewer of these cases than formerly and have had no reason to regret this change in policy. The percentage of cholecystectomies not drained ranged from 20 per cent in 1935 to 46 per cent in 1938 with no increase in the mortality and no deaths from cholecystectomy in 1938 when almost one-half our cases were undrained. It is our belief that if proper hemostasis has been carried out with peritonealization of all surfaces, drains are unnecessary and may even be harmful. They add pain to the postoperative convalescence with resultant decrease in vital capacity; contribute to the general weakness of the wound; and give discomfort at the time of withdrawal.

But if drainage is to be employed, a cigarette drain with a gauze core which under no circumstances should extend beyond the rubber tissue is inserted down to the foramen of Winslow. The omentum is then brought up to the site of operation, the clamp is released from the round ligament, all gauze sponges are removed, and the liver is returned to its normal position. Some surgeons prefer to make a counter stab wound to the right of the major wound along the left costal margin to permit the cigarette drain to be brought out in this location. In making this stab wound care must be taken that no active bleeders are cut which will continue to bleed internally. When the surgeon is certain that there is no bleeding, the cigarette drain is anchored with silk to the skin. A routine closure is then effected.

After operation special attention is given to prophylaxis against pulmonary complications; the patient is placed in a semi-Fowler position, is moved from side to side frequently, and rebreathes carbon dioxide three to four times a day. The adhesive dressings and binder should not be tight enough to restrict breathing. Should pulmonary complications develop, the binder is further loosened. Since pulmonary embolus is an all too frequent catastrophe associated with biliary surgery, we have recently added several procedures to our routine care of patients in the hope of lessening its occurrence. The legs are raised to heart level immediately after operation and kept elevated for several days. Bicycle exercises are

encouraged starting on the first postoperative day. Women receive daily douches starting on the first postoperative day in an effort to overcome local venous stagnation, since the pelvic venous plexus is the source of many emboli. In addition vaginal hygiene may lower the incidence of such complications as cystitis.

Usually 2000 to 3000 c.c. of 5 per cent dextrose in isotonic saline is given intravenously during the first twenty-four hours after operation, the total being regulated to insure a urinary output of approximately 1000 c.c. daily. All intravenous fluids are given slowly. We prefer to administer fluids intravenously instead of subcutaneously in the great majority of instances, but in elderly patients or those with cardiac difficulty fluids are best administered subcutaneously to be taken up as needed.

TABLE 1
OPERATIONS FOR CHOLELITHIASIS
Peter Bent Brigham Hospital 1934–1938

	Number	Average Age	Mortality Per Cent
Total operations*	397	..	4
Cholecystectomy			
Chronic cholecystitis	166	45	1
Acute cholecystitis	67	51	3
Cholecystectomy and choledochostomy	136	54	5
Re-exploration of common duct	9	58	11
Cholecystostomy			
Acute cholecystitis	19	55	21

* Gallstones were recovered in 94 per cent of all operations on the gall-bladder and common duct (exclusive of carcinoma and stricture).

Cigarette drains are removed within twenty-four to forty-eight hours unless there is bile leakage when the drain is not removed until a sinus tract has formed, usually five to seven days.

The average postoperative hospitalization for patients having cholecystectomy has been seventeen days. Our mortality in 166 cholecystectomies for chronic cholecystitis and cholelithiasis was 1 per cent, in sixty-seven for acute cholecystitis 3 per cent. (Table 1.)

Upon discharge patients are given instructions to follow a low fat diet and to avoid for several months those foods that proved upsetting before operation. Medical supervision is required for several months at least to insure the maximum relief from the surgical procedure.

COMMON DUCT STONE

One of the most common and serious mistakes in surgery of the gall-bladder and extrahepatic bile ducts is the surgeon's failure to search for and remove calculi located in or beyond the cystic duct. Sufficient statistics have been accumulated both from autopsy reports and clinical material to show that in approximately 20 per cent of all cases of cholelithiasis a stone is located in the intrahepatic or extrahepatic ducts exclusive of the cystic duct or gall-bladder. (Table II.) From a study of the cases of cholelithiasis at the Peter

TABLE II
COMMON DUCT STONE
Peter Bent Brigham Hospital 1934–1938

		Per Cent Mortality
Total operations for cholelithiasis	397	4
Cholecystectomy and choledochostomy	136	5
Choledochostomy	9	11
Incidence of choledochostomy*	36.5%	
Incidence of common duct stones in choledochostomy	51.0%	
Incidence of common duct stones in all cases†	18.5%	
Choledochostomy		
Stones recovered	74	9
Negative	71	0

* Annual incidence of choledochostomy varied from 51 per cent to 26 per cent.
† Annual incidence of common duct stones varied from 28 per cent to 12 per cent.

Bent Brigham Hospital over a five-year period, we find that the annual percentage of common ducts opened ranged from 51 to 26 per cent, that surprisingly enough the number of cases in which a common duct stone was recovered averaged 51 per cent of the ducts opened; that our annual incidence of common duct stone has varied between 28 and 12 per cent in direct proportion to the number of ducts opened. Since the number of common duct stones recovered will depend upon the number of ducts opened and explored, there is not much question that the incidence of choledochostomy should range between 40 and 50 per cent of operations for cholelithiasis. Our incidence of common duct stones recovered, and this does not include mud and debris, was 18.5 per cent of all cases operated upon for cholelithiasis. A stone located in the common duct is a serious

complication which demands consideration in the differential diagnosis of the patient with biliary disease, and a determined effort must be made in every case submitted to surgery for cholelithiasis to make certain that none is overlooked.

The diagnosis of common duct stone is usually made from a history of jaundice, colic, vomiting, chills and fever associated with a past history consistent with a diagnosis of cholelithiasis. More and more it is being recognized that stones will occur in the common duct without accompanying jaundice or pronounced colic. However, colic is present in at least 90 per cent of the cases of common duct stone at some time, and practically all cases give a past history consistent with biliary tract disease. Initial and persistent epigastric pain strongly suggests that a calculus is distending the cystic or common duct. The incidence of epigastric pain is higher in the presence of a common duct stone than in any other complication of cholelithiasis. Not only is the location of the pain suggestive, but frequent and repeated attacks of colic imply the passage of multiple stones through the cystic duct into the common duct. The location and frequency of the pain should be carefully noted in every case of suspected cholelithiasis because each may offer a valuable clue to the position of the calculi.

Although digestive disturbances are commonly associated with cholelithiasis and many patients have nausea with induced vomiting, we believe that pronounced involuntary vomiting gives evidence of a stone outside the gall-bladder within the cystic or common duct. This is derived from our experimental observation that while distention of the gall-bladder does not cause vomiting, distention of the common duct constantly produces spontaneous vomiting.[26,27] We noted that involuntary vomiting occurred in approximately 90 per cent of our patients with common duct stone. When vomiting is pronounced, we consider it suggestive evidence of a cystic or common duct stone, even in the absence of jaundice. A definite number of patients with common duct stones have such a marked weight loss as a result of nausea, intolerance to food, and even vomiting that, when associated with jaundice, a diagnosis of malignancy may be suspected.

While chills and fever have long been associated with common duct stone, they occur in only about one-third of our cases. However, a history of cholangitis with cholelithiasis definitely suggests that the common duct should be explored.

Jaundice was noted either on admission or in the history of 85 to 90 per cent of our cases. The surgeon should keep this in mind at the time of operation, because, unless the operative findings clearly contraindicate a diagnosis of common duct stone, a choledochostomy may be wise. It cannot be too strongly emphasized that common duct stones may be found in patients whose jaundice occurred years before operation. There is too great a tendency to disregard the diagnosis of common duct stone unless the patient is markedly jaundiced at the time of operation.

Since jaundice so often accompanies cholelithiasis and other disease of the biliary tract, it requires special consideration. The common causes of obstructive jaundice which are benefited by surgery are mechanical blocking of the biliary system, usually from acute or chronic inflammation associated with calculi, and tumor of the ducts or the head of the pancreas.[30] The importance of attempting to differentiate between these two lesions cannot be overestimated. In the presence of malignant obstruction of the common duct the jaundice will probably be progressive in type, and early operation is advisable; while in the case of common duct stone obstruction a more conservative treatment may be judicious, and operation may be delayed until the jaundice has subsided and the patient is in a better general condition. One of the most important diagnostic points in favor of common duct stone is a past history consistent with gall-bladder disease which is obtained in practically 100 per cent of these cases. In addition 80 to 90 per cent of the patients with common duct stone have colic. At least one-third of the patients have jaundice one or more times previous to the present illness. The mere presence of jaundice, therefore, has not so much differential diagnostic value as the history of intermittent or decreasing jaundice. While a marked loss of weight is more suggestive of malignancy than common duct stone, it is present in about one-fourth of the stone cases due no doubt to the fact that many of these patients have a persistent nausea and intolerance to food. Common duct stones occur nine times in women to once in men. This sex ratio, although not specific, may occasionally influence the physician in making a diagnosis. The physical examination also may be of definite value in making such a differential diagnosis. The patient with common duct stone may be tender in the right upper quadrant or epigastrium, but almost never has an enlarged gall-bladder. Courvoisier's law, therefore, is

fairly accurate and may be of considerable value in making a differential diagnosis.

Certain laboratory examinations aid considerably both in making a diagnosis and in determining the best time for surgery. In addition to the routine urine and blood examinations, determinations of the icteric index are taken on alternate days in the acute phases of the disease. If after several days the jaundice is decreasing, operation is postponed until the temperature, if elevated, returns to normal and the patient shows general physical improvement as well as a more normal laboratory chart. A more complicated but valuable laboratory procedure is a determination of blood diastase, for when pancreatitis is associated with common duct calculus surgery is delayed. For this reason we make a blood diastase determination at the time the patient with jaundice is admitted. When the patient is seen early, the diastase is frequently elevated, but a diastase determination is only of diagnostic value within forty-eight to seventy-two hours after the onset of jaundice since it usually falls to normal limits thereafter.[6] If the diastase is elevated, it would seem preferable to delay operation until it returns to normal, a minimum period of three or four days.

During the period of observation the bleeding and clotting times are determined in every case of jaundice regardless of the severity. A determination of the blood prothrombin level is usually unnecessary unless a definite bleeding tendency is encountered. However, it is true that the bleeding and clotting times, as determined by the usual methods, may be normal yet the patient have a prothrombin content so low that with the inevitable blood loss from the surgical operation, postoperative bleeding may occur. It is advisable, therefore, as a routine to give vitamin K supplemented by bile salts three times daily for four or five days previous to operation, the dosage depending upon the improvement in the bleeding and clotting times and the prothrombin level. In our experience, however, some patients become so nauseated that they cannot tolerate the administration of vitamin K by mouth; it must then be given by intraduodenal instillation. With the success of vitamin K in controlling hemorrhagic tendencies the administration of calcium and other anticoagulents is no longer indicated. Since an occasional patient, despite adequate doses of vitamin K, will continue to show a bleeding tendency, we believe that every severely jaundiced patient subjected to surgery

should be typed, and donors should be available at the time of operation and in the immediate postoperative period.

The same preoperative preparation as recommended under chronic cholecystitis is carried out. In addition, an attempt is made to obtain a glycogen reserve in the liver. This is best accomplished by encouraging the carbohydrate intake by means of a high carbohydrate, high vitamin diet. If the patient is unable to take carbohydrates by mouth because of nausea, vomiting, or general lack of appetite, 1000 to 2000 c.c. per day of 10 per cent dextrose may be given intravenously. Such concentrated solutions, however, must be given very slowly at the rate of about 500 c.c. per hour to avoid a diuretic effect.

Since these patients are on the average slightly older (54 years as compared to 45 years) and the mortality in these cases is about five times higher than in uncomplicated cholecystectomy, every detail of the preoperative preparation is carefully planned to bring each patient to operation in as good condition as possible. As previously stated, if the jaundice is subsiding, operation is delayed in the patient suspected of having a common duct stone until the icterus practically disappears. However, if the icterus remains constant or increases and the patient shows signs of cholangitis, as manifested by chills and fever, operation is carried out as soon as the fluid balance is properly adjusted.

Here again the anesthetic used depends upon whether or not the patient is jaundiced, since avertin is not given in the presence of jaundice. In elderly, poor-risk patients local infiltration of novocaine without adrenalin is satisfactory. In general the surgeon should use the type of anesthesia with which he is most familiar, as well as that which can be best given with the facilities available.

Before operation the surgeon should review the patient's history, especially in regard to the following points, and weigh well the possible need for choledochostomy.[8] Is the patient jaundiced or is there a history of jaundice? Has he had frequent attacks of gallstone colic or epigastric pain? Has there been pronounced involuntary vomiting? Is cholangitis associated with cholelithiasis? Have there been recurrent symptoms after cholecystectomy? With one or more of these findings present, the surgeon should realize before operation that exploration of the common duct may be necessary, but the operative findings will tip the balance.

As a routine in every operation on the biliary tract the common duct is thoroughly palpated, as described under cholecystectomy. But the decision to do or not to do a choledochostomy should not

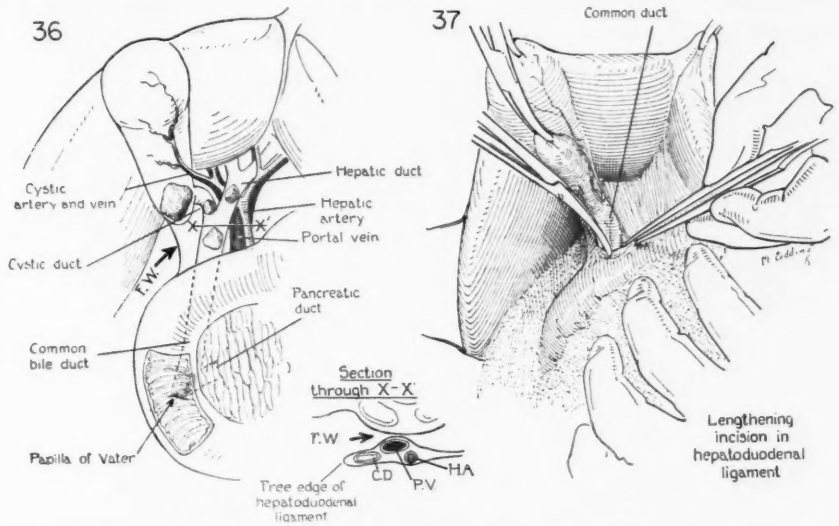


FIG. 36. Schematic drawing of the gall-bladder and extrahepatic ducts with adjacent structures showing the common locations of calculi. The cross section through x-x' shows the relationship of the common duct to other structures in the hepatoduodenal ligament.

FIG. 37. The hepatoduodenal ligament is divided to give adequate exposure of the common duct.

depend solely on palpation of the common duct. It is our impression that in general too much confidence is placed on the physical finding of whether or not the surgeon is able to palpate a stone within the duct. Frequently because of associated pancreatitis the head of the pancreas is considerably thickened, a finding which should influence the surgeon to do a choledochostomy. If upon palpation the gall-bladder is found to contain many small stones and the cystic duct is dilated so that one or more stones could conceivably pass, choledochostomy is compulsory. Conversely, if the surgeon finds an exceedingly small cystic duct and by palpation determines that the calculi within the gall-bladder are such that they could not possibly have passed through the cystic duct, choledochostomy is unnecessary even though many of the indications from the history are present. Many symptoms, such as involuntary vomiting and jaundice, may be produced by the inflammatory reaction about a stone located in the ampulla of the gall-bladder or cystic duct. The size of the

cystic duct, therefore, is of major importance. In the presence of a small, contracted, nonfunctioning gall-bladder, the common duct is always explored, for then it is usually impossible to determine

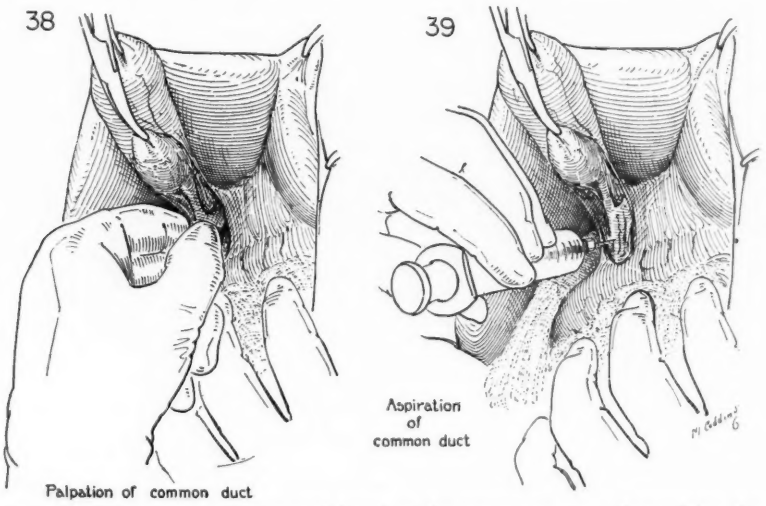


FIG. 38. The common duct and head of the pancreas are palpated by the left hand of the surgeon.

FIG. 39. The location of the common duct is verified by aspiration and the consistency of the bile is noted as a possible indication for subsequent exploration of the common duct.

whether or not a stone is present without exploration. Under these circumstances, the common duct is usually dilated.

Choledochostomy. The details of exposure of the region of the common duct are described under chronic cholecystitis. The common locations of gallstones are shown in Figure 36. The small inset (Fig. 36) shows the relationship of the common duct to the portal vein and hepatic artery. Since it is necessary by actual inspection and visualization to note not only the size of the common duct but its thickness and any other signs of inflammation present, the peritoneum over it is carefully incised, allowing adequate exposure from the cystic duct downward as well as up over the common hepatic duct for a short distance. (Fig. 37.) When this is done carefully, it is usually unnecessary to ligate any vessels. In the presence of jaundice the cystic duct should not be divided nor the gall-bladder removed until the surgeon is certain that any obstruction in the region of the papilla can be removed; the gall-bladder may be needed for a short-circuiting procedure. For this reason in the severely jaundiced patient clamps are not applied to the cystic ducts, and the blood

supply of the gall-bladder is not interfered with until the possibility of carcinoma of the head of the pancreas is eliminated.

The common duct can usually be identified by its color and the fact that a small blood vessel runs along the anterior surface. After the duct is freed, it is palpated to see whether any stones can be felt. (Fig. 38.) It is always excellent judgment to identify the common duct by aspiration of bile through a fine hypodermic needle. (Fig. 39.) In addition to confirming its location, information as to the consistency and thickness of the wall and the appearance of the bile is ascertained.

Visualization of the common duct by the injection of a radio-opaque substance, such as hippuran or lipiodol, has been advocated in recent years at this stage of the operation in order that negative explorations of the common duct may be avoided and a lower mortality may result.[18] We do not take cholangiograms routinely at this time and see no reason to change our attitude toward opening the common duct whenever there is the slightest question that a stone may be located there. During the past five years seventy-one choledochostomies were done without recovering a stone and without a death. Our deaths following choledochostomy have all been in patients in whom a common duct stone was recovered. From our experience, therefore, negative choledochostomy has not added to the general mortality.

After an adequate and satisfactory exposure of the common duct is obtained, traction sutures are applied to it at a convenient point, usually just below the junction of the common hepatic and cystic ducts. (Fig. 40.) Some prefer to explore the common duct through the dilated cystic duct, even incising its margin to permit the exploration in this fashion. To us this seems a difficult approach which does not permit as thorough exploration of the common duct as we believe advisable. Allis forceps should not be applied to the margins of the duct; gentle traction may be obtained more safely by silk sutures. The field is entirely walled off with moist gauze packs, and a glass suction tube is placed down to the foramen of Winslow to remove bile as it escapes at the time the duct is opened. With a small, sharp knife, an opening, usually about 1 cm. in length, is made parallel to the long axis of the duct, avoiding if possible the blood vessel commonly found on its anterior wall. (Fig. 41.) This opening must be large enough to admit a small scoop without traumatizing or tearing the duct. The color and consistency of the bile is noted. A metal

probe, such as a uterine sound, is then directed downward through the papilla of Vater into the duodenum. (Fig. 42.) Not only can the patency of the papilla be determined at this time but, with a finger

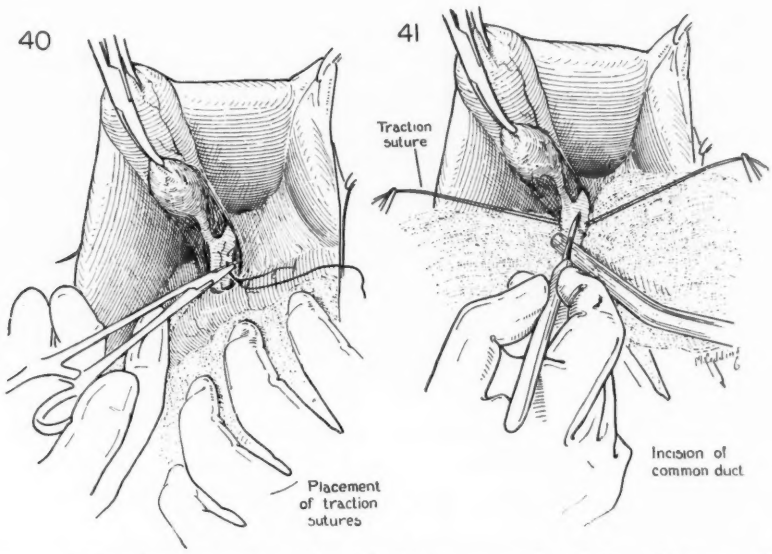


FIG. 40. Traction sutures are placed in the common duct below the point of entrance to the cystic duct in preparation for choledochostomy.
FIG. 41. The field is walled off with gauze packs, and an incision is made between the traction sutures into the common duct.

inserted in the foramen of Winslow to give counter-resistance as the metal probe passes, the surgeon may sense a grating of metal against stone. In this way a calculus which otherwise may be overlooked is found. The mere fact that the probe passes into the duodenum should not lull the surgeon into a false sense of security because frequently this is the case and yet calculi are either not impinged in the region of the ampulla or else are resting in a sacculation of the duct at this point. (Fig. 36.) A small pliant metal scoop is then directed downward into the region of the ampulla repeatedly and stones, if present, are removed. (Fig. 43.) A scoop 8 by 15 mm. with an easily moulded handle is entirely adequate; large scoops with rigid handles should not be used. The entire procedure is carried out very gently. The scooping is then directed upward into both hepatic ducts, for small calculi not uncommonly lurk in the larger intrahepatic bile ducts. (Fig. 44.) The scooping and subsequent steps of the exploration cannot be too thoroughly carried out, because autopsy findings, after even the most thorough explora-

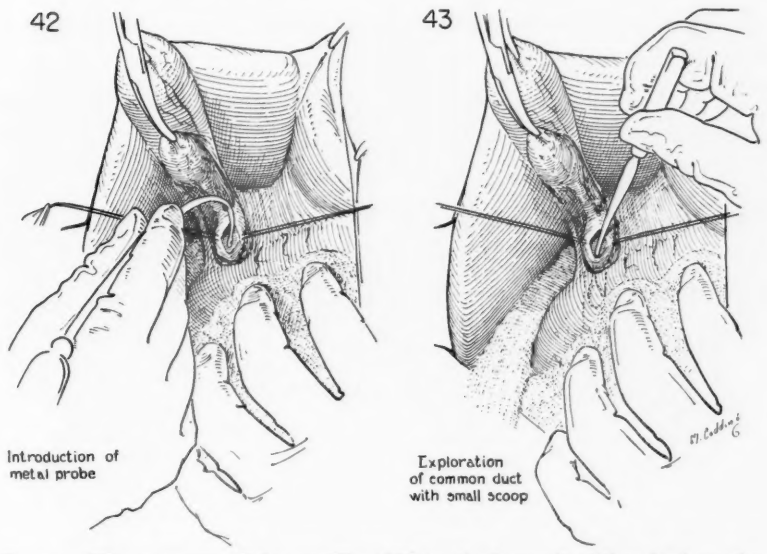


FIG. 42. The patency of the papilla of Vater is determined by the insertion of a uterine sound.

FIG. 43. A small scoop is introduced into the common duct down to the region of the papilla.

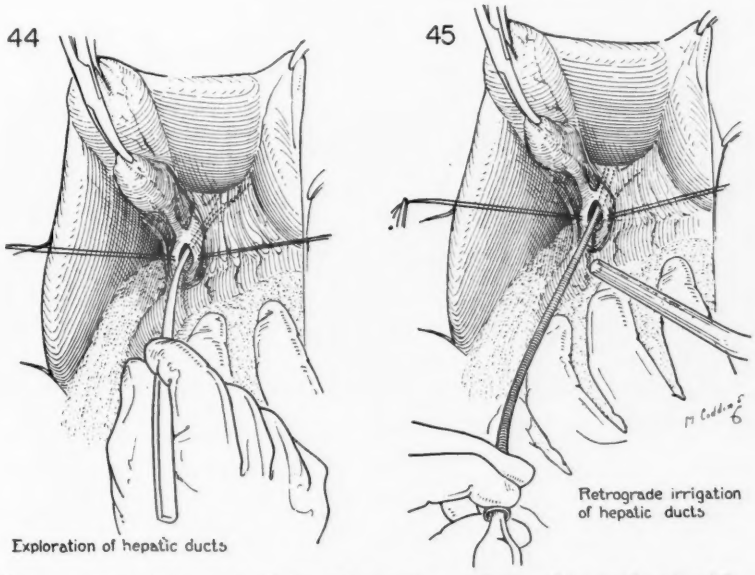


FIG. 44. The right and left hepatic ducts are thoroughly explored with a small scoop.

FIG. 45. The hepatic ducts are irrigated with saline through a silk woven catheter to dislodge any calculi.

tion, show in a distressingly high percentage of cases that small calculi are overlooked.

After the scooping has been carried out in such a fashion that the wall is not unduly injured and the opening in the common duct is

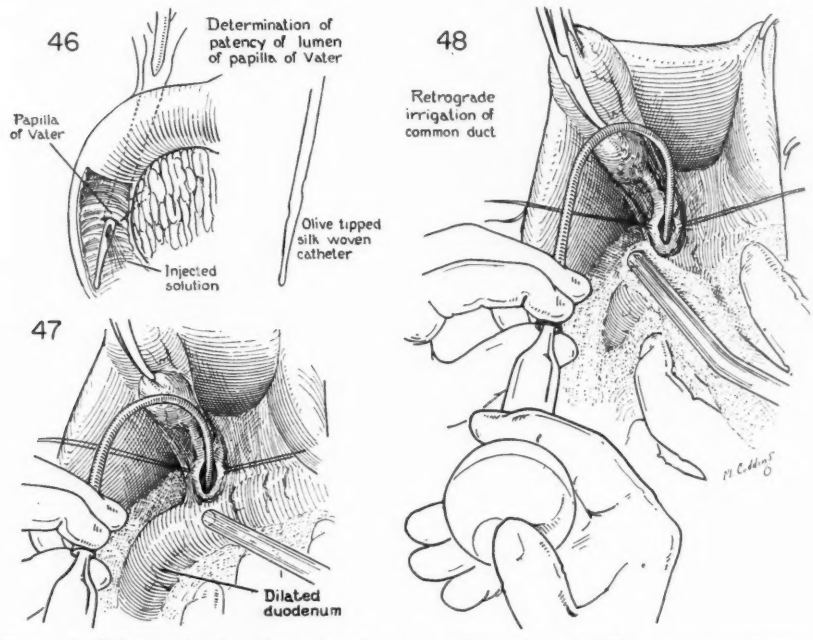


FIG. 46. Schematic drawing showing the olive tipped silk woven catheter within the lumen of the duodenum.

FIG. 47. A silk woven catheter has been passed through the papilla of Vater and its patency established by ballooning out the duodenum by the injection of saline.

FIG. 48. Saline is injected into the catheter as it is withdrawn to float up any debris or calculi in the common duct. The regurgitated material is aspirated through a glass suction tube.

not torn, a silk woven catheter, No. 12 or No. 14 French, is inserted toward the liver, and warm saline (110°F.) is injected as the catheter is withdrawn. (Fig. 45.) Under no circumstances should the surgeon guess at the temperature of the saline that he injects but should depend on thermometer reading. The stream of saline must be forceful as the catheter is withdrawn in an effort to dislodge and wash downward any calculi in the hepatic ducts. Meanwhile suction is maintained in the field to remove the escaping fluid. The catheter is then directed downward, and the surgeon notes the sudden increase in resistance encountered when it passes through the papilla of Vater into the duodenum. (Fig. 46.) Saline is injected and, if the

tip of the catheter is within the lumen of the duodenum, flows on to balloon out the duodenum. (Fig. 47.) We sometimes inject several hundred c.c. of saline through the catheter, since it offers an easy and convenient means of giving fluid. Saline is again injected vigorously with the asepto syringe as the catheter is withdrawn slowly to dislodge any calculi present. (Fig. 48.) Following this, the scooping is repeated.

Flexible silk woven catheters offer an ideal means for determining the patency of the papilla of Vater and permitting injection of saline to dislodge any calculi. Many surgeons prefer to pass bougies, starting with a No. 12 and increasing to a No. 14 or perhaps a No. 16 or larger, in an effort to dilate the papilla of Vater; while others recommend dilatation of the papilla of Vater almost to the size of the common duct by any method preferred, the contention in either case being that dilatation will permit better drainage of bile and the escape of overlooked common duct stones.[1] But it is our impression that a sphincter cannot be dilated all at one time and remain permanently enlarged. As a matter of fact forcible dilatation of the sphincter should result in immediate edema and subsequent scarring as a result of trauma to the papilla of Vater. For this reason a series of experiments, using various types of commonly accepted dilators was carried out in our clinic in animals.[4] These experiments proved to our satisfaction that in animals at least there resulted hemorrhage and inflammation in the acute stages following attempted dilatation of the papilla of Vater. The scarring, following this, resulted in a smaller opening than that which followed cholecystectomy alone. Therefore it would seem undesirable to attempt forcible dilatation of the papilla of Vater in patients undergoing cholecystectomy.

That dilatation of the papilla of Vater does not always leave a patulous lumen through which any overlooked calculi may escape can be shown by postoperative perfusion and ductal pressures.[29] We have found that on the first two days after operation the perfusion pressure was twice normal, showing the effect of the edema, no doubt from the attempted dilatation. The readings were taken at least six hours after the administration of morphine. In the presence of such pressures it is obvious that calculi could not pass, at least during the early stages. We have no evidence to support our theory that subsequent scarring and difficulty occur except that which can be gathered from our experimental findings. Control

experiments with a small catheter inserted into the cystic duct in a patient who did not have a choledochostomy and in whom the papilla of Vater was not disturbed were carried out. There resulted

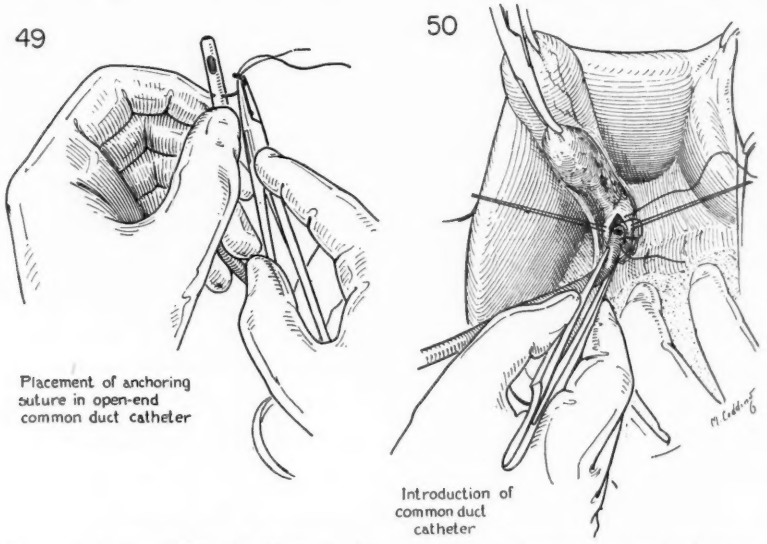


FIG. 49. A small bite is taken in the open-end catheter about 1 inch from the tip in preparation for anchoring it within the common duct.
FIG. 50. A small bite of common duct wall is taken with the anchoring suture. The catheter is directed up the hepatic duct.

only a slight elevation in perfusion pressure during the first few postoperative days, and the graph line was surprisingly flat. With this critical evidence to support our experimental findings, we feel rather strongly that the patency of the papilla of Vater should be determined by gentle methods and that under no circumstances should an effort be made to dilate it forcibly.

The problem of whether or not the common duct should be drained after it is explored has been debated for a long time. Some prefer to close the common duct primarily with fine silk sutures and to drain it through a small catheter inserted through the cystic duct;[25] others close the common duct primarily and insert a drain down to the point of closure. It is our custom to use a very small, open-end catheter (No. 16). The catheter is anchored with a silk suture about 2 to 3 cm. from its open end to the upper end of the common duct including just a small bite of the duct tissue (Figs. 49, 50 and 51); it is directed up the hepatic duct; and the suture is tied tight. By including only a small bite of the common duct and by tying the ligature tight it will slough through in a few days per-

mitting the catheter to be withdrawn. We do not recommend the use of T tubes or other types of angulated tubes, because they seem unnecessary and are more likely to traumatize the common duct

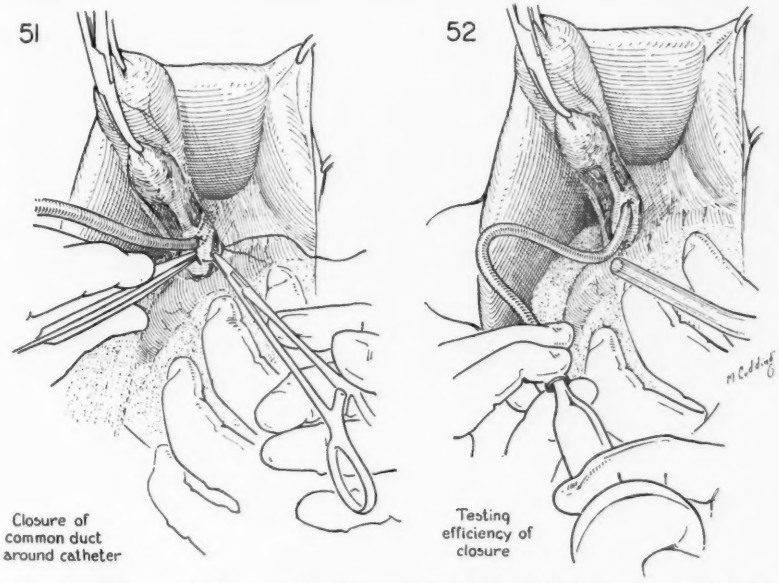


FIG. 51. The anchoring suture is securely tied, and the common duct is closed about the catheter.

FIG. 52. The efficiency of the common duct closure is tested by the injection of saline.

than a single catheter. However, if a T tube is used, the prolonged arms should be excised to cause as little trauma at the time of removal as possible. After the catheter has been anchored in place, the traction sutures are removed, and the common duct is closed with interrupted sutures of fine silk at the lower angle of the wound. (Fig. 51.) Saline is then injected to test the opening in the common duct. Obviously if the saline is injected under pressure, fluid will escape; but if the closure is relatively water tight, there will be no general escape of bile because the action of siphonage will prevent distention of the common duct after operation. (Fig. 52.) The subsequent steps of cholecystectomy are then carried out.

At this time in those patients having many stones in the common duct it is advisable to inject a radio-opaque substance, such as lipiodol, for a cholangiogram, since in the presence of multiple small stones in the common duct there is always the chance that some may be hidden within the hepatic radicles and be overlooked. It will also prove helpful in those instances where a probe or catheter does not

pass through the papilla into the duodenum by showing the contour of the stone and aiding materially in starting the subsequent steps of the surgical procedure. Similarly when a negative exploration of

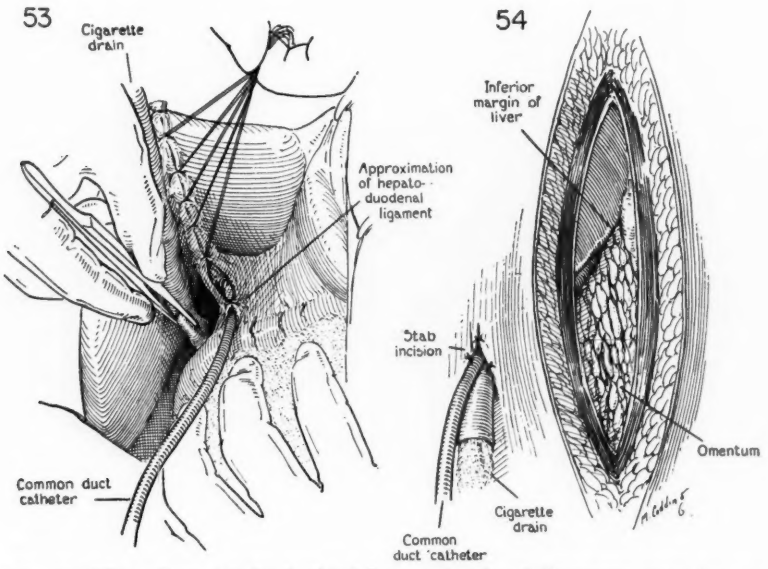


FIG. 53. The edges of the incised hepatoduodenal ligament may be approximated over the common duct. A cigarette drain is inserted into the foramen of Winslow.

FIG. 54. The catheter and cigarette drain are brought out unangulated through the wound or through a stab incision.

the common duct results, a cholangiogram may be useful to rule out stricture of any portion of the ducts as well as an overlooked calculus. It also should be considered in the case of a secondary choledochostomy.

The peritoneum about the common duct may be approximated with interrupted sutures. Whenever possible, the liver bed is peritonealized with interrupted sutures. (Fig. 53.) A final inspection is made to make certain that the common duct is not angulated or otherwise injured and that there is no evidence of bleeding. A cigarette drain is inserted down to the foramen of Winslow under the same circumstances as after simple cholecystectomy. After the table is levelled, the omentum is directed upward to cover the field of operation. The catheter and drains are brought out through the wound or through a stab wound to the right of the incision at a point where the drains will pass obliquely downward from the liver margin unangulated. (Fig. 54.)

Transduodenal Approach. In rare instances when it is impossible to dislodge a calculus from the region of the papilla of Vater by careful and repeated manipulation a more drastic approach must

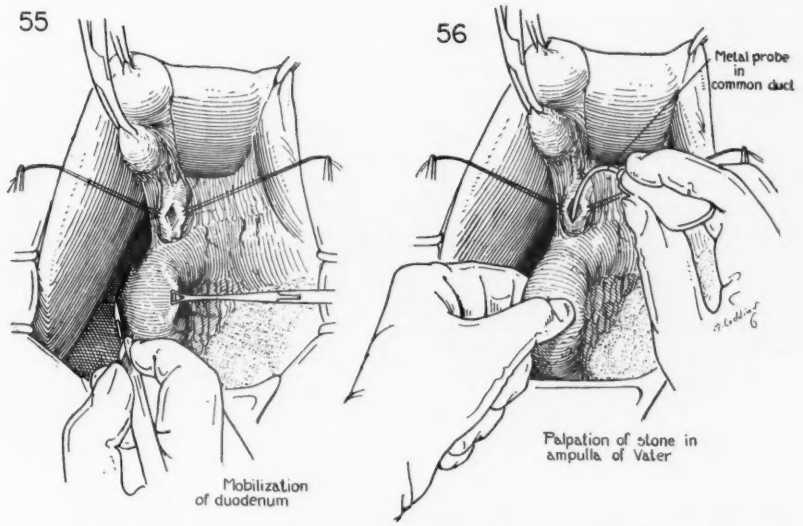


FIG. 55. The lateral peritoneal attachment of the second portion of the duodenum is incised in preparation for its mobilization.
FIG. 56. The position of the impacted calculus is more accurately determined after the duodenum has been mobilized.

be followed. Under such circumstances it is necessary to mobilize the duodenum and expose the papilla of Vater through a transduodenal approach. Since choledochostomy has already been done, an incision is now made in the lateral peritoneal attachment of the duodenum so that the second portion of the duodenum can be mobilized. (Fig. 55.) After the peritoneal attachment has been incised, either with a knife or scissors, blunt gauze dissection is used to sweep the duodenum medially. Occasionally this will expose the retroduodenal portion of the common duct, permitting more direct palpation, which, with the aid of a scoop in the common duct, may dislodge the calculus. (Fig. 56.) The scoop is passed down to the region of the ampulla, and its course is directed carefully with the index finger and thumb of the left hand of the surgeon. (Fig. 56.) Should this also prove unsuccessful, the anterior duodenal wall is incised, exposing the papilla of Vater.

By exerting gentle pressure on a uterine probe inserted in the common duct the surgeon can determine by palpation over the anterior wall of the duodenum the exact location of the papilla

of Vater. (Fig. 57.) With the duodenal wall held taut in Allis clamps or by traction sutures of silk, an incision 3 to 4 cm. in length is made over this area parallel to the long axis of the bowel. The field

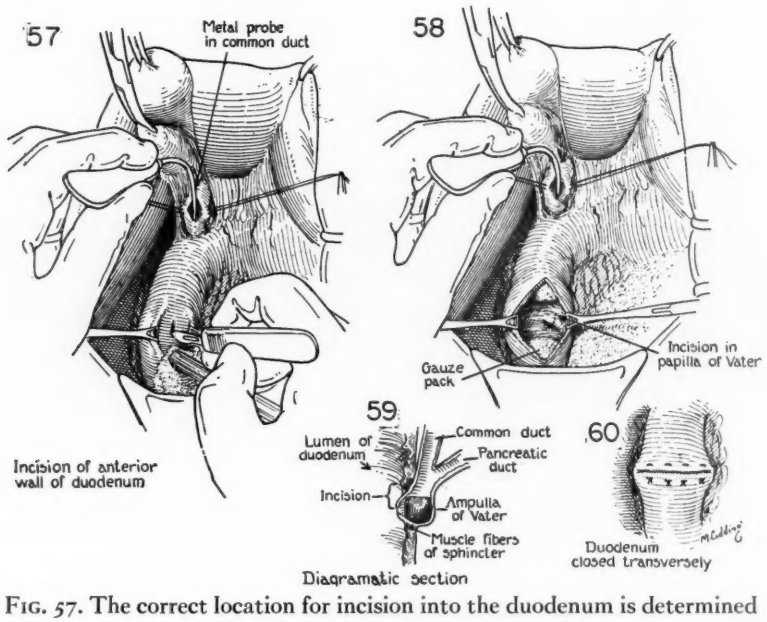


FIG. 57. The correct location for incision into the duodenum is determined by means of a metal probe in the region of the papilla.

FIG. 58. The lumen of the duodenum has been walled off with a gauze pack. A small incision is made directly into the papilla with the metal sound in place.

FIG. 59. Cross-section of the papilla of Vater showing the impacted stone and the extent of the proposed incision into the papilla.

FIG. 60. The duodenal wall is carefully closed in the direction opposite to which the incision was made to prevent stenosis.

must be completely walled off by gauze sponges, and constant suction must be maintained to avoid contamination by bile and pancreatic juice. Small bits of gauze are then introduced upward and downward within the lumen of the duodenum to prevent further soiling. (Fig. 58.) Even at this point by direct palpation the calculus may be dislodged. If this is still impossible, the probe is reintroduced and directed firmly against the region of the papilla of Vater to disclose the general direction of the duct so that a small incision may be made directly parallel to it. (Fig. 58.) This incision enlarges the papilla of Vater so that the calculus can be expressed. (Fig. 59.) Any bleeding points from the incision into the papilla of Vater are controlled by fine interrupted silk sutures. No effort is made to

reconstruct the papilla to its natural size, the opening being allowed to remain enlarged as a result of the incision.

Following removal of the calculus, bougies are introduced from above and repeated scooping and irrigation are carried out to make certain that no further calculi remain within the common duct. The small gauze sponges which plugged the duodenum are withdrawn, and the intestine is closed. To avoid constriction of the lumen of the bowel it is advisable to close the bowel in the opposite direction from which the incision was made. The duodenal wall is sutured with continuous silk on a straight milliner's needle, starting at the angle adjacent to one of the Allis clamps so that the knot is tied on the inside, and continuing as a Connell stitch over to the opposite clamp. Here again the knot is tied on the inside of the lumen so that the entire stitch may slough within the duodenum. The serosa is reinforced with a layer of interrupted silk Halsted mattress sutures placed with straight milliner's needles. (Fig. 60.) This closure must be water tight and secure to avoid the distressing complication of a duodenal fistula. A bougie is reintroduced into the common duct, and the duodenum is distended with saline to make certain that there is no leakage. A small common duct catheter is then directed into the opening of the common duct in the supraduodenal portion, and the technique from this point on carried out as described under choledochostomy. A cigarette drain should be inserted down to the suture line in all cases to remain until there is no danger of a duodenal fistula.

A few special instruments drawn to scale in Figure 61 are recommended for cholecystectomy and choledochostomy. The silk woven catheter (Eynard No. 12 or 14) has a bulbous tip which expedites its passage through the papilla of Vater, and two eyes which permit direct injection of saline to prove the patency of the papilla and flushing of the ducts to wash out sand and mud as the catheter is withdrawn. The soft rubber catheter (Eynard No. 16) has an open end and an eye on one side. The small gall-bladder scoop, which because of its flexible handle should be a part of every surgeon's equipment for operations on the biliary tree, is in reality a Cushing pituitary scoop. These are available in various sizes. The Lower clamp which curves less sharply than a right-angle clamp, thereby permitting easier division of tissue between clamps serves the purpose of a right-angle clamp, and because of its length is more useful for cholecystectomy in our opinion.

Although we have not had a death in five years following a negative exploration of the common duct, the mortality has been 9 per cent when a stone was recovered from the common duct. With

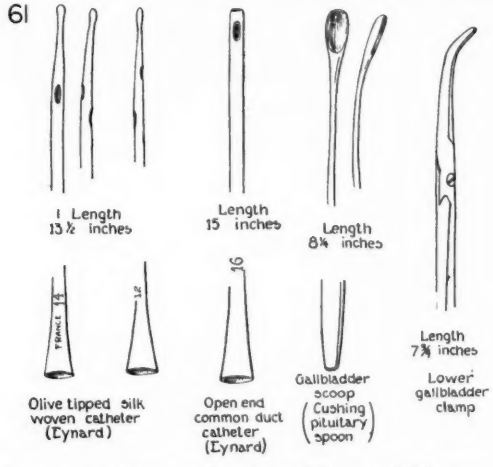


FIG. 61. Scale reproduction of the special instruments mentioned in the technique for cholecystectomy and choledochostomy.

such a high mortality compared to other operations on the biliary tract, it is important for the surgeon to keep in mind the seriousness of this operation and plan the postoperative care in great detail. The usual postoperative care as outlined under cholecystectomy is followed. But the patient having choledochostomy has also a draining catheter which must be watched closely. The surgeon is responsible for seeing to it that the catheter is adjusted to a constant drainage bottle immediately after the patient is returned to the recovery room and that it is not kinked or angulated. The amount of drainage from the common duct catheter is charted for each twenty-four hour period. When a small, open-end catheter is used, this usually averages 200 to 500 c.c. daily. If bile drainage ceases, the tube should be irrigated with sterile saline solution. The amount of drainage from the catheter frequently decreases from day to day and by the end of the tenth or twelfth day the catheter is removed. Usually there is no drainage twenty-four to forty-eight hours after its removal. Should the catheter be accidentally pulled out during the early postoperative period, no disastrous effects have resulted in our experience. We have at times followed the principle of keeping the drainage bottle elevated to direct more bile into the duodenum and to avoid too rapid decompression of the biliary tract. However, this

principle has not been strictly adhered to and we cannot present statistical evidence as to its effect on the postoperative course of the patient.

If the patient drains an excessive amount of bile or the amount of bile does not decrease, we attach the ordinary sterile intravenous saline outfit to the common duct drainage tube and note at what level above the common duct bubbles appear within the bottle, indicating that saline is entering the duodenum. This determines whether or not the papilla of Vater is patent and the resistance offered bile entering the duodenum. We do not use perfusion pressures routinely to determine when the catheter should be removed, but reserve the determination for the occasional patient in whom there is some question as to the patency of the papilla of Vater. If preferred, the common duct catheter may be clamped for one to two hours after meals, starting after the first week, to direct the bile into the duodenum. If the clamping of the tube produces distress, perfusion pressures should be taken to determine the patency of the papilla of Vater. We do not bother to clamp off the tube routinely because of the efficiency of the perfusion pressure in giving us the desired information. When high pressure readings are found, a cholangiogram is taken to determine whether there is a calculus or merely spasm of the sphincter of Oddi. It has not been our custom to do a routine postoperative cholangiogram because of the fever and discomfort it causes in some patients. A cholangiogram during the postoperative period may be indicated when a patient has recurrent pain or when profuse bile drainage persists beyond the usual interval. We believe that it should not be used routinely to determine the time when the catheter should be removed.

If it is shown by postoperative cholangiogram that a common duct stone was overlooked, an attempt may be made to dislodge it by irrigation through the common duct catheter, first with sterile saline which must be aspirated, and then with warm oil.[2] Occasionally the injection of oil by reducing the amount of friction will ease out the stone without further treatment. Nitroglycerine or atropine is always given before irrigation to insure relaxation of the papilla of Vater. Some surgeons advise the injection of ether in the belief that it will dissolve the stone, but we have not followed this suggestion.

In elderly patients who have been severely jaundiced there frequently develops a general apathy toward food following operation especially associated with loss of bile. In such instances the

patient is refed bile to the amount of several hundred cubic centimeters daily, usually by means of an intranasal Levine tube, although some patients will take bile mixed with tomato juice directly by mouth. These patients may be given 10 per cent dextrose by vein to increase the caloric intake.

If the patient has been deeply jaundiced, the administration of vitamin K is continued during the early postoperative period, and the icteric index is determined every four or five days. Stools are checked to make sure that bile is reaching the gastrointestinal tract. Five per cent dextrose in saline is given intravenously to maintain a urinary output of at least 1000 c.c. daily, but in the aged or those with cardiac disease subcutaneous administration is preferable. The average patient receives 1500 c.c. night and morning until fluids are taken by mouth. The amount of bile drainage must be taken into consideration in calculating the fluids necessary to be given the patient.

Cholangitis is not an uncommon complication of common duct stone. It is manifest by chills and not infrequently the classical intermittent fever of Charcot. In addition to the treatment described earlier under common duct stone, we have occasionally given patients with concomitant cholangitis sulfanilamide on the premise that cholangitis is associated with various organisms, some of which are known to be responsive to sulfanilamide therapy. But our results with this specific drug therapy have been variable. After operation in patients who have had cholangitis the common duct catheter is retained for a longer period than in the uncomplicated case. In no instance, however, has a common duct catheter been left in place longer than two or three weeks.

If a patient presents the symptoms of a common duct stone at a later date, an attempt may be made by suitable medication to encourage passage of the stone, the medication being directed toward relaxing the papilla of Vater and at the same time increasing the secretory pressure from the liver. The plan of treatment as outlined by Best and Hicken involves a three-day program. The first and third days .01 gr. of nitroglycerine is given by mouth three times a day; on the second day 0.1 gr. of atropine three times a day. In an effort to promote the flow of bile 2 or more ounces of epsom salts in warm water are given each morning, and each evening an ounce of cream or olive oil is given by mouth. During this three-day period a tablet of decholin is given four times a day to increase

the outflow of bile unless the patient is jaundiced. It is advisable to examine the stools both during this period and for a few days following to determine whether any stones have passed by way of the gastrointestinal tract. We have had no proved case, however, in which this regimen was effective.

ACUTE CHOLECYSTITIS WITH AND WITHOUT STONE

Although the classical description emphasizes the occurrence of pain in the right upper quadrant with radiation to the angle of the scapula accompanied by a tender mass in the right upper quadrant, the symptomatology of acute cholecystitis may be quite varied. Because of the extent of the acute inflammation, it would be expected that the chief complaint of the majority of patients would be right upper quadrant pain. However, this is not always the rule, for it has been found that epigastric distress is nearly as common. Occasionally the chief complaint is localized pain or tenderness in the left upper quadrant or even in the right lower quadrant. Acute distention of the gall-bladder or ducts as proved by our experimental observations may explain the high incidence of epigastric distress, especially in the early stages of acute cholecystitis. It should be remembered also that not every patient having acute cholecystitis develops involuntary muscle spasm or a mass in the right upper quadrant. As a matter of fact an analysis of 235 cases of acute cholecystitis in the Peter Bent Brigham Hospital over a period of twenty years showed that muscle spasm of the right upper quadrant was present in 60 per cent at the time of admission and a mass in the region of the gall-bladder in only 32 per cent.[5] This may be explained by the fact that a thick-walled gall-bladder covered by the liver does not bear any direct relation to the anterior parietal peritoneum, and as a result the patient does not develop rigidity in the right upper quadrant although severe epigastric pain as the result of distention of the gall-bladder and cystic ducts is experienced.

Acute cholecystitis is one of the serious complications of gall-bladder disease and requires careful judgment in its surgical treatment. In our opinion cases of acute cholecystitis fall into one of three clinical groups. The first group (approximately 40 per cent) will respond promptly to the generally accepted conservative measures, intravenous administration of fluid, sedatives, semi-Fowler position, heat to the upper abdomen, and constant gastric suction if distention is present. This therapy is aimed at treating

and improving the general condition of the patient. These patients will show such marked improvement under this regimen that surgery may be carried out safely within forty-eight hours of the time of hospital admission. A second and slightly larger group (50 per cent) responds more slowly. This is because the severity of the inflammatory reaction reduces the vital capacity and in spite of an adequate fluid balance and intake of food, the operative risk remains high. The fever, physical findings, and leucocytosis decrease gradually. Moreover, the surgeon may find an advanced degree of inflammation in the gall-bladder even when surgery has been delayed several days after the physical and laboratory findings are within normal limits, for though the general condition has been improved, the local pathology remains much the same. It is for this reason that we do not prolong the preoperative period. A third and fortunately smaller group (5 to 10 per cent) does not respond to the conservative treatment as outlined. The fever remains high, leucocytosis increases, and the physical findings in the right upper quadrant become more marked. It is apparent that these patients have a fulminating infection with impending or actual perforation; therefore immediate drainage of the gall-bladder is planned as soon as the fluid balance is corrected.

The explanation of these differing clinical conditions seems to us to result from the underlying etiologic mechanism. Thus what is usually classified as acute cholecystitis is chiefly a mechanical lesion in which obstruction to venous and lymphatic escape occurs, with resultant edema of the gall-bladder wall, which in turn further shifts its efficiency as a dialyzing membrane. Such cases, when seen early, present no additional risk. Unfortunately the surgeon has difficulty in distinguishing the simple mechanical acute cholecystitis from serious bacterial invasion. In the former group delay improves the condition, in the latter great delay may prove disastrous.

It has been our experience that patients with acute cholecystitis are in better condition for surgery if sufficient time is taken to correct the fluid balance as outlined in the conservative plan of treatment.[5] In our opinion a higher mortality will result in the hands of surgeons with limited experience if insufficient time is taken to prepare the patient properly for operation. The danger of a free perforation of the gall-bladder with a resultant general peritonitis is relatively uncommon in patients undergoing conservative preoperative treatment.

Upon admission to the hospital the patient with acute cholecystitis is treated conservatively by the well standardized method of semi-Fowler position, morphine for pain, heat or cold to the right upper quadrant, and the intravenous administration of dextrose in isotonic saline. Since these patients may have considerable distention, it may be advisable to place them on constant gastric suction according to the Wangensteen method. If there is a mass in the right upper quadrant, it is wise to determine accurately whether the mass is increasing or decreasing in size. The amount and extent of spasm and rigidity of the abdomen are determined several times daily. Each day a white count and differential are made and also a determination of the vital capacity, which may give valuable information as to the general improvement because so often patients have a marked limitation in their respiratory excursions as a result of the general tenderness in the right upper quadrant. It is the response to the general therapy which dictates the period of delay before surgery. If rapid improvement follows, surgery is performed once the fluid balance is corrected.

While in the great majority of our cases classical cholecystectomy as described in Figures 1 through 35 is carried out, not infrequently in the patient suffering from acute cholecystitis the surgeon encounters a thick walled, tense, edematous gall-bladder with a stone impacted in the region of the ampulla and many adhesions attached to its under surface. Under such circumstances it is usually unwise to attempt a classical cholecystectomy because of the difficulty in isolating the region of the cystic duct and the possibility of accidental injury to the common duct or right hepatic artery. Rather than attempt to work blindly in this location by starting in a retrograde fashion, the operator should decide either upon a cholecystostomy with simple drainage of the gall-bladder with the idea of carrying out a cholecystectomy later when the infection has subsided, a partial cholecystectomy, or if the general condition of the patient is good, removal of the gall-bladder from the fundus downward.

Cholecystectomy from the Fundus Downward. The field is well walled off with moist gauze pads, and the contents of the gall-bladder are aspirated through a trocar. A culture is taken of this aspirated fluid. As the trocar is withdrawn, a curved half-length clamp closes the opening to prevent soiling of the field. With the fundus of the gall-bladder retracted upward and outward and with

traction maintained on the round ligament as well, any adhesions to the under surface of the gall-bladder are separated by means of sharp and blunt dissection. (Fig. 62.) An incision is then made

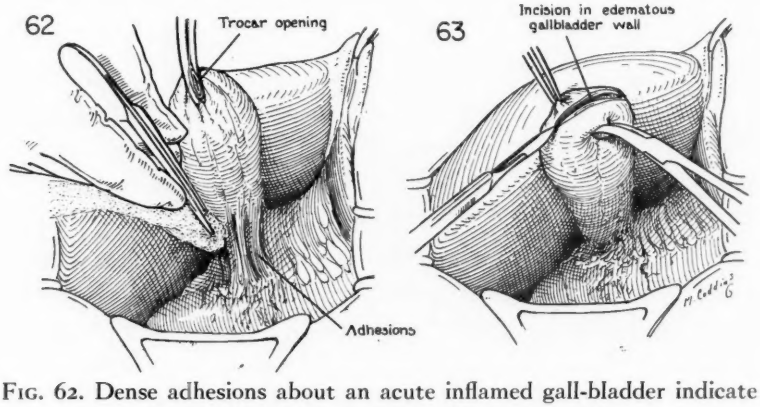


FIG. 62. Dense adhesions about an acute inflamed gall-bladder indicate removal of the gall-bladder from the fundus downward.

FIG. 63. An incision is made in the edematous wall to develop a cleavage plane to facilitate enucleation of the gall-bladder from the fundus downward.

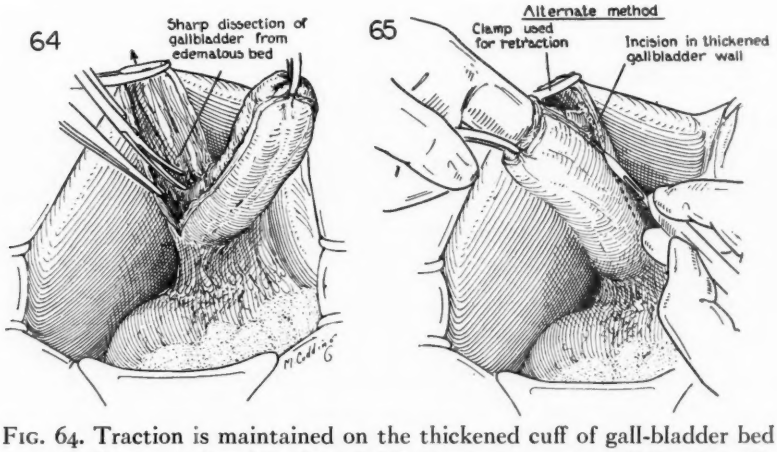


FIG. 64. Traction is maintained on the thickened cuff of gall-bladder bed at the liver margin while the gall-bladder is retracted medially to facilitate its dissection.

FIG. 65. As an alternate method the opening in the fundus may be enlarged and the index finger of the surgeon inserted to aid in the subsequent dissection and enucleation of the gall-bladder.

through the edematous serosa starting first around the fundus of the gall-bladder and extending downward on either side about 1 cm. from the liver substance. (Fig. 63.) Usually an avascular cleavage plane can be developed. The importance of incising the serosa early cannot be overemphasized because otherwise the acutely inflamed

gall-bladder may be torn from the liver, leaving an oozing raw liver surface. The cuff of thickened gall-bladder wall at the margin of the liver is held with a curved hemostat while the gall-bladder is further freed by means of sharp dissection. (Fig. 64.)

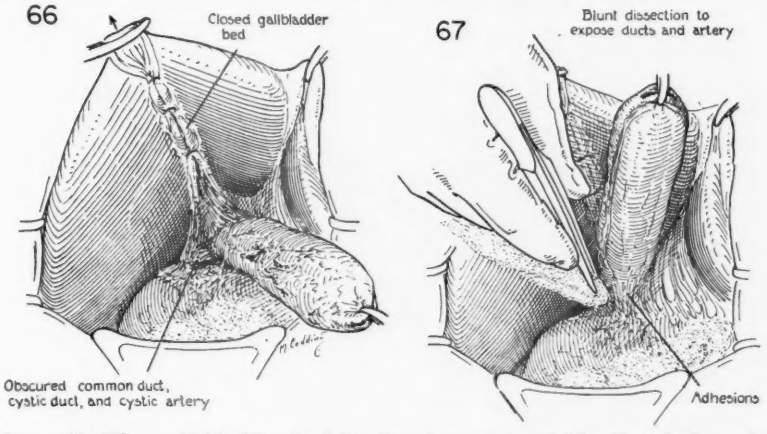


FIG. 66. The gall-bladder bed is closed to control bleeding before the cystic duct structures are isolated. Note that traction is maintained at the liver margin.

FIG. 67. Alternate blunt and sharp dissection is used to isolate the cystic duct and artery.

As an alternate method, since the contents of the gall-bladder have been aspirated and are frequently sterile, the opening in the fundus of the gall-bladder is enlarged, permitting the left index finger of the operator to be inserted to give counter-resistance and at the same time aid in dissecting the viscus within the previously developed cleavage plane. In other words, the gall-bladder can now be used much the same as a hernial sac when one is trying to separate it from its surrounding adhesions. (Fig. 65.)

The serosa is incised on each side alternately by sharp dissection until the region of the ampulla is encountered. Since there may be troublesome oozing because the cystic artery is still intact, all bleeding points are accurately clamped. The thickened gall-bladder is closed with interrupted silk sutures. The cuff of serosa at the margin of the liver is held by a curved half-length clamp throughout. (Fig. 66.) If the proper cleavage plane was not developed and the raw liver surface was exposed, an effort must be made to approximate these surfaces. Sutures of silk or fine atraumatic catgut on French needles are passed deep into the liver substance along the margin of the gall-bladder bed and are tied carefully to compress the bed, but not tear the liver substance. Great care must be taken in isolating

the ampulla of the gall-bladder from the common duct. Alternate sharp and gauze dissection is advisable until the majority of adhesions have been separated. (Fig. 67.)

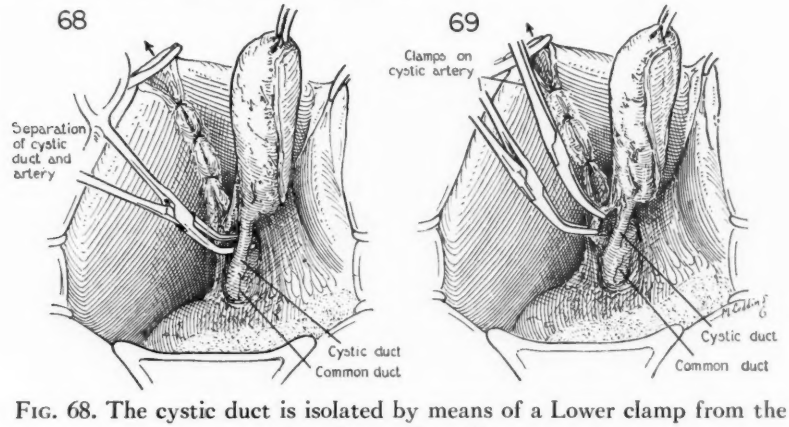


FIG. 68. The cystic duct is isolated by means of a Lower clamp from the common duct and cystic artery.
FIG. 69. The large cystic artery is clamped. It may be impossible to isolate it from all the surrounding inflammatory tissue.

After the ampulla of the gall-bladder has been carefully isolated from the region of the common duct, the cystic duct is isolated with the usual Lower clamp, very gingerly to avoid injury to the blood supply as well as to the common duct. (Fig. 68.) The cystic artery is next isolated with its accompanying indurated tissue, but an effort is not necessarily made to separate it as an individual vessel. The surgeon should keep in mind that when this procedure for cholecystectomy is necessary the cystic artery may be much larger than normal and the vessels may be in an anomalous location. The right hepatic artery should be definitely located lest it be clamped and divided. The cystic artery and adjacent tissues are then divided between a half-length and a right-angle clamp. (Fig. 69.) The artery is carefully ligated with a transfixing suture of fine silk. (Fig. 70.)

Attention is now directed toward the cystic and common ducts. It must be remembered that common duct stones are not infrequent in the presence of acute cholecystitis. During the past four years in the Peter Bent Brigham Hospital we have found it necessary to explore the common duct in 32 per cent of our acute cases with recovery of a common duct stone in one-half those explored or 16.5 per cent of all cases. A stone impacted in the cystic duct does not preclude a stone in the common duct, especially if the cystic duct is large and the stones in the gall-bladder are small.

If choledochostomy is to be included, the cystic duct is not divided until the common duct is explored. Otherwise it is divided and tied with a transfixing suture of fine silk. (Fig. 71.) After the

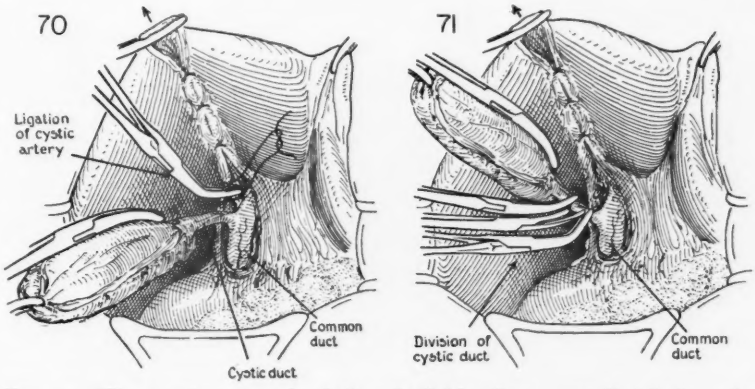


FIG. 70. The cystic artery is tied and all bleeding controlled before the cystic duct is divided because it may be necessary to explore the common duct.

FIG. 71. If exploration of the common duct is unnecessary, the cystic duct is divided and ligated in the usual fashion.

area has been repeatedly inspected for oozing, the clamp is removed from the liver margin, and a final suture is taken to close the gall-bladder bed at the liver margin. Since the local inflammation and technical difficulties have made this type of removal necessary, it is usually wise to insert a cigarette drain down to the region of the cystic duct. Should an area of raw liver surface be exposed, drainage is always indicated because of the danger of bile leakage. A routine closure follows.

Partial Cholecystectomy. Instead of removing an acute, gangrenous gall-bladder from the fundus downward, some surgeons prefer to aspirate the contents of the gall-bladder and then partially resect it, leaving intact that portion adjacent to the liver.[10] This is a safe and satisfactory type of operation and offers as good a mortality and end result as cholecystectomy. It will, in a certain percentage of cases, save a patient from a second operation for complete removal of the gall-bladder. As far as can be determined there is no harmful effect from the remaining gall-bladder wall. This procedure may also be of value in those instances where the gall-bladder is so deeply buried in the liver that technical difficulties make cholecystectomy hazardous.

The field is exposed and the gall-bladder drained as for cholecystectomy from the fundus downward. The gall-bladder wall is excised down to the region of the cystic duct which may or may not

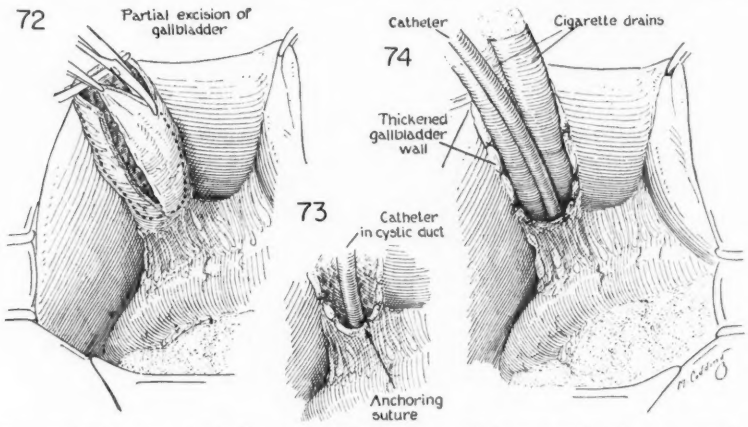


FIG. 72. The acutely inflamed gall-bladder wall is excised adjacent to the liver margin.

FIG. 73. If the cystic duct is not ligated, an attempt should be made to institute bile drainage by the insertion of a catheter.

FIG. 74. Following cauterization of the remaining gall-bladder wall and control of all bleeding points, several drains are placed in the remaining gall-bladder bed.

be ligated. (Fig. 72.) When the cystic duct is not ligated an attempt is made to insert a small catheter for bile drainage (Fig. 73), which is anchored in position with a transfixing suture. Any bleeding about the thickened, edematous gall-bladder wall is controlled either with a continuous stitch or interrupted sutures. An effort is made to destroy the remaining mucosa of the gall-bladder either by the application of actual cautery or some fixative, such as phenol or Carnoy's solution.

When this procedure is followed, it is implied that the common duct cannot be explored, and no effort is made to do so although a few patients will require reoperation. A postoperative cholangiogram may be taken in those instances where a catheter has been inserted to ascertain whether a common duct stone is present, necessitating a second operation after the infection has subsided. Several cigarette drains are introduced down into the region of the cystic duct, and the omentum is brought up around these drains. A routine closure follows.

Cholecystostomy. Cholecystostomy, while no longer recognized as a routine method of treatment for the patient with cholelithiasis,

is occasionally a life-saving procedure in the presence of a fulminating, acute cholecystitis and was the procedure of choice on nineteen occasions during the past five years at the Peter Bent Brigham Hospital. Of the fifteen patients who recovered from cholecystostomy, five had a subsequent cholecystectomy during the same hospital stay. We look on this operation as a temporary procedure only, an invaluable aid in preparing the acutely ill patient for a subsequent cholecystectomy and thorough exploration of the biliary system after the infection has subsided and the patient is in better physical condition. Furthermore it is prudent to perform cholecystostomy in an elderly, poor-risk patient where removal of calculi is necessary because of repeated bouts of colic. On rare occasions in patients with obstruction of the common duct, long-standing jaundice, and a tendency toward hemorrhage which cannot be brought under control by vitamin K and transfusion, preliminary drainage of the biliary tract by means of cholecystostomy is in excellent judgment.

Usually the surgeon after a careful evaluation of the patient's condition realizes that cholecystostomy is the operation of choice. Under novocaine anesthesia a small incision is then made directly over the tender mass in the right upper quadrant so that its mid-portion will come directly over the maximum point of tenderness, usually the region of the fundus of the gall-bladder. Occasionally when technical difficulties or the severity of the infection involving the gall-bladder are not suspected previous to operation, it may be necessary to carry out this procedure through the usual right rectus incision.

No effort is made to dissect the adhesions from the under surface of the gall-bladder. The fundus of the gall-bladder is walled off with gauze in preparation for evacuating its contents. (Fig. 75.) An incision is made just through the serosa of the bulging fundus at the apex of the presenting dome of the gall-bladder, and a trocar is thrust through the thickened, edematous wall to remove as much of the liquid contents as possible. (Fig. 76.) Constant suction is maintained adjacent to the opening in the fundus as the trocar is withdrawn. A culture is taken routinely. The surgeon should inspect the aspirated fluid and estimate whether it is pus or bile-stained. It should be remembered that, even though the contents of the gall-bladder may appear purulent, they are frequently sterile, because the inflammatory reaction so often results from a mechan-

ical rather than a bacterial basis. After the trocar is withdrawn, the edematous wall is grasped in Allis clamps and the opening in the fundus is extended by scalpel or dissecting scissors. (Fig. 77.) The

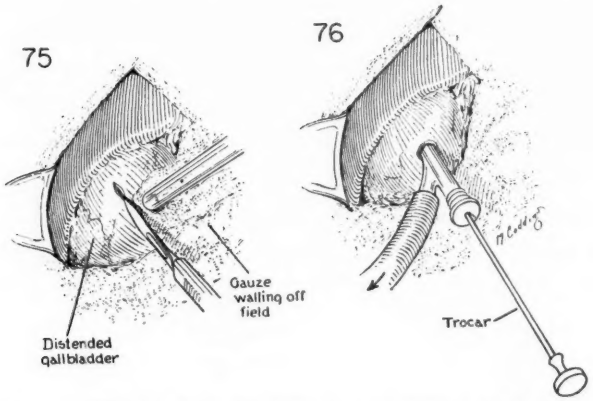


FIG. 75. The fundus of the acutely inflamed gall-bladder is walled off with gauze sponges, and an incision is made through the edematous wall in preparation for insertion of a trocar.

FIG. 76. The contents of the distended gall-bladder are aspirated through a trocar.

suction tube may be introduced into the lumen of the gall-bladder to remove any remaining liquid or grumous material. Since there is probably an impacted stone in the ampulla or cystic duct, an effort must be made to remove it to permit the escape of bile and drainage of the infected biliary ducts. A small, flexible gall-bladder scoop is introduced down to the region of the ampulla. (Fig. 78.) If the stones cannot be dislodged with a scoop, a fenestrated forceps may then be used. (Figs. 79 and 80.) If this too fails, no further attempt is made to remove the calculus, for frequently it is impossible to remove a stone held by the surrounding inflammation and the operation should not be needlessly prolonged.

The lumen of the gall-bladder is washed repeatedly with saline to flush out any remaining debris. A large rubber tube with a lumen at least 1 cm. in diameter is inserted down to the region of the ampulla and anchored to the fundus with an interrupted suture. (Fig. 81.) A purse-string suture of silk is placed in the fundal wall to close the gall-bladder snugly about the drainage tube. One or more sutures are taken to anchor the fundus to the peritoneum to prevent the possible escape of gall-bladder contents into the peritoneal cavity until the area is sealed off. (Fig. 82.) A routine

closure is then carried out. If the infection is severe or if an abscess is encountered and there has been soiling about the wound, a rubber tissue drain is inserted. After a sterile dressing is applied, the

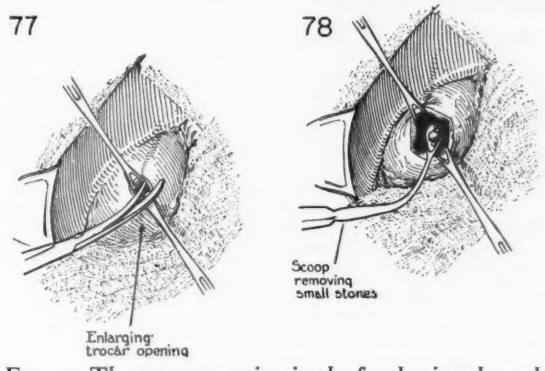


FIG. 77. The trocar opening in the fundus is enlarged to permit removal of calculi in the region of the ampulla.

FIG. 78. An attempt is made to remove calculi from the region of the ampulla by means of a scoop to relieve the cystic duct obstruction.

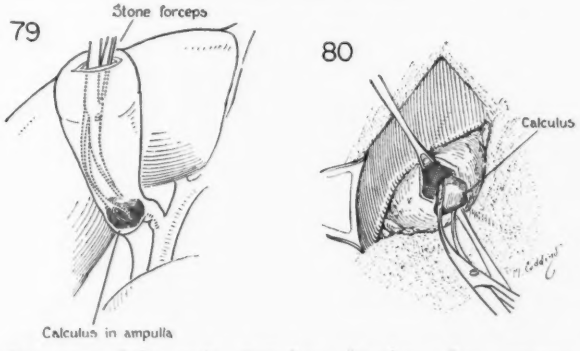


FIG. 79. Schematic drawing showing the common location of an impacted calculus in the ampulla.

FIG. 80. The removal of this impacted calculus may be facilitated by the use of a fenestrated stone forceps.

catheter is anchored to the skin with a suture or adhesive tape and is connected to a drainage bottle.

Following operation the patient is maintained in a semi-Fowler position, the fluid balance is corrected by the intravenous administration of fluids and the standard routine as described under chronic cholecystectomy is followed. Removal of the drainage tube will depend upon the amount of drainage from the catheter and the general condition of the patient as determined from the fever and

physical examination of the abdomen. Usually the catheter can be removed at the end of ten to fourteen days, and drainage from the sinus tract will cease shortly thereafter. While the tube is in place,

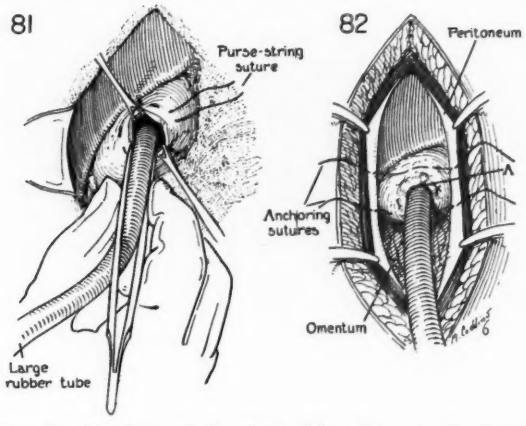


FIG. 81. Drainage is instituted by the use of a large soft rubber catheter inserted down to the region of the cystic duct. The opening in the gall-bladder is closed with a purse-string suture about the drainage tube.

FIG. 82. The drainage tube is anchored to the gall-bladder with suture A. The fundus of the gall-bladder, in turn, is anchored to the peritoneum.

hippuran or lipiodol may be injected, and a roentgenogram may be taken for evidence of overlooked calculi in the region of the ampulla, cystic duct, or common duct. If the general condition of the patient is good and the immediate postoperative recovery is uncomplicated, a subsequent cholecystectomy may be performed through the original wound two weeks after the original operation. However, if the patient is elderly or has been seriously ill, he is usually sent out of the hospital to return after three to four months for cholecystectomy. The only time that a secondary operation after cholecystostomy is not recommended is in the extremely poor-risk patient.

During the past five years there were 123 cases of acute cholecystitis at the Peter Bent Brigham Hospital subjected to operation, with a gross mortality of 7 per cent; in 115 there was also an associated cholelithiasis. (Table III.) Although the number of preoperative days of hospitalization averaged five regardless of the type of surgical procedure carried out, approximately 40 per cent of our cases of acute cholecystitis were operated upon within forty-eight hours. Cholecystectomy was performed in sixty-seven instances with

a mortality of 3 per cent. In addition, although it has often been implied that patients with acute cholecystitis are not so liable to common duct stone, the surgeon, after taking into consideration the various positive factors in the history of each patient, as previously mentioned, as well as the operative findings, felt justified in opening the common duct in thirty-seven cases or slightly more than one-third of those having cholecystectomy for acute cholecystitis. Common duct stones were recovered in 51 per cent of the choledochos-

TABLE III

ACUTE CHOLECYSTITIS

Peter Bent Brigham Hospital 1934–1938

		Average Days Pre-operation Hospitalization	Operation within 48 Hours	Per Cent Mortality
Total cases	123	5	....	7
With cholelithiasis	115			
Without cholelithiasis	8			
Treatment				
Cholecystectomy	67	5	32%	3
Cholecystectomy and choledochostomy	37	5	40%	8
Cholecystostomy	19	5	60%	21

Common duct stones recovered	19
Incidence of common duct stone	16.5%
Stones recovered at choledochostomy	51.0%

tomies, or 16.5 per cent of the total acute cases. There was a general mortality of 8 per cent when common duct exploration was added to cholecystectomy; but in no instance was there a death following negative exploration of the common duct. Cholecystostomy was performed nineteen times with a mortality of 21 per cent. These nineteen were the poor risk patients with an advanced degree of inflammation, who probably would have presented a much higher mortality had more extensive surgery been attempted. In our opinion there was no instance where delay in operation was responsible for the increased mortality rate.

RESULTS OF OPERATIONS FOR CHOLELITHIASIS

Complications. During the five-year period, 1934–1938, fifty-two, or 13 per cent, of our cases of cholelithiasis had postoperative complications. As would be expected, pulmonary complications were

the most common and occurred with greatest frequency in patients with acute cholecystitis or common duct stones. Surgery of the upper abdomen always carries a high incidence of pulmonary complications and this is especially true for procedures on the biliary system. Atelectasis was reported in seventeen patients, bronchopneumonia in five, a subphrenic abscess which required drainage in three, and two had a minor pulmonary embolus but recovered. It is apparent, therefore, that a pulmonary complication is the chief danger of the postoperative period and such measures as have been emphasized throughout under postoperative care should be instituted at once.

The second most common complication was wound infection, which occurred in sixteen instances, usually associated with acute cholecystitis. In two cases there was wound disruption. The interpretation of a wound infection no doubt varies with the individual surgeon and the severity of the infection, but we included those cases which showed induration although it was unnecessary to institute drainage.

Phlebitis occurred in six instances. This is a rather dreaded complication because it may be a forerunner of pulmonary embolus, which has been our most common cause of death. An attempt has been made, as stated in the postoperative care, to avoid this complication by elevating the legs immediately after operation, instituting bicycle exercises, and giving daily douches to women starting on the first postoperative day.

The balance of our complications consisted of two cases of hematoma, two of biliary fistula, and one of stricture of the common duct. Such complications may seem inevitable, but some are avoidable by the use of a precise technique in which the steps are carried out with adequate exposure.

Mortality. During the same period there were 397 operations for cholelithiasis, with a gross mortality of 4 per cent. Death occurred most frequently (eight cases), as shown in Table IV, in those cases where a common duct stone was recovered at operation. When a common duct stone was recovered, the cause of death was pulmonary embolus (four), gas bacillus infection (one), cardiac failure (one), acidosis (one) and hepatorenal syndrome (one).

We are loathe to make a diagnosis of hepatorenal syndrome, for in reviewing one hundred deaths occurring after surgery of the biliary tract we have failed to find more than a few which fill its requirements. We are in complete accord with the findings of

Touroff who believes that the surgeon should not classify deaths after surgery as hepatorenal syndrome unless all other causes have been ruled out and unless the characteristic changes involving the kidneys, liver, etc., are verified by autopsy and microscopic examination. Although some of these patients will present a terminal clinical

TABLE IV

DEATHS FOLLOWING OPERATIONS ON THE BILIARY SYSTEM*

Peter Bent Brigham Hospital 1934–1938

Age	Operation	Common Duct Stone	Path. Diagnosis	Days Post-operative	Cause of Death
72	Cholecystectomy and choledochostomy	Yes	Chronic	12	Pulmonary embolism†
62	Cholecystectomy and choledochostomy	Yes	Chronic	5	Gas bacillus†
62	Cholecystectomy and choledochostomy	Yes	Acute	21	Pulmonary embolism†
58	Cholecystectomy and choledochostomy	Yes	Chronic	9	Acidosis, hepatorenal syndrome(?)
59	Cholecystectomy and choledochostomy	Yes	Acute	20	Pulmonary embolism†
71	Cholecystectomy and choledochostomy	Yes	Chronic	1	Cardiac failure
72	Cholecystectomy and choledochostomy	Yes	Acute	13	Hepatorenal syndrome†
75	Choledochostomy	Yes	.....	5	Pulmonary embolism
76	Cholecystostomy	....	Acute	9	Bronchopneumonia†
67	Cholecystostomy	....	Acute	6	Bronchopneumonia, cholangitis†
48	Cholecystostomy	....	Acute	1	Abscess of liver†
57	Cholecystostomy	....	Acute	36	Acute pancreatitis†
63	Partial cholecystectomy—Closure cholecystoduodenal fistula	....	Acute	1	Pulmonary embolism†
44	Cholecystectomy	....	Acute	8	Pulmonary embolism†
48	Cholecystectomy	....	Chronic	7	Bronchopneumonia
54	Cholecystectomy	....	Chronic	2	Pulmonary embolism
62	Average age				

* Exclusive of malignancy.

† Verified by autopsy.

history of rapid pulse, weakness, and progressive failure, which could be fitted into what is described in the literature as a typical picture of liver death, subsequent autopsy usually disclosed as the direct cause of death some unsuspected infection, such as subphrenic abscess, liver abscess, pancreatitis, peritonitis, concealed

hemorrhage or pulmonary embolus. We believe that one is not justified in designating a liver death without an adequate autopsy examination and that the so-called "liver death" or hepatorenal syndrome is rarely encountered. As a matter of record, in only one instance over this five-year period was the pathologist in complete accord with this diagnosis.

There were four deaths associated with cholecystostomy for acute cholecystitis, giving a mortality of 21 per cent. The mortality was high even though 60 per cent of these patients with acute cholecystitis were operated upon within forty-eight hours after admission to the hospital when their fluid balance had been adjusted and it was apparent that their condition was not improving. We fail to see how any change in clinical treatment would lower this mortality rate because these patients died as a result of an overwhelming infection. In our opinion, the fact that the mortality was so great gives strength to the clinical judgment which prompted cholecystostomy, for no doubt the mortality would have been higher had cholecystectomy been attempted.

There were only two deaths in the patients having cholecystectomy for chronic cholecystitis, giving an operative mortality of 1 per cent. As pointed out previously, this group was composed of younger, better risk patients and so gave a lower mortality rate. It is significant that during this five-year period, when a high percentage of these cases were operated upon by the surgical house staff that there were no deaths as the result of technical mistakes or hemorrhage.

Follow-Up. Upon discharge from the hospital, patients having the gall-bladder removed or drained are given instructions to follow a low fat diet and to avoid for several months those foods that proved upsetting before operation. Any tendency toward constipation should be corrected, preferably by a morning saline cathartic. Each patient reports within a week for inspection of the wound and at regular intervals thereafter for a period of at least two years. If any patient has residual symptoms an attempt is made to overcome these by dietary measures and medication.

The records during this five-year period show that 212 patients were seen six months or longer after operation. No letter follow-ups were considered. Eleven complained of recurrent colic and severe distress; thirty-eight, including the eleven mentioned above, complained of some gas and indigestion. In addition there were eight

herniae, amounting to 4 per cent of the cases followed. The common duct was re-explored in nine instances, with recovery of common duct stones in six.

It is apparent, therefore, that although 94 per cent of the patients operated upon had calculi and the majority had colic, gas or mild indigestion was frequently reported after operation, clearly indicating the great importance of postoperative medical supervision.

INJURY TO THE EXTRAHEPATIC DUCTS

End-to-End Anastomosis. In rare instances the common duct may be accidentally divided. This is most likely to occur just below the junction of the hepatic and cystic ducts due to the technical errors described in Figures 16 and 21. The surgeon should be aware of an error at the time of operation and take steps to remedy it. Under such circumstances a direct end-to-end anastomosis is done with fine silk suture material. The peritoneum to the lateral wall of the duodenum should be divided, and an effort made to mobilize the duodenum because in all types of anastomosis of the common duct there must be absolutely no tension on the suture line. To this end mattress sutures of silk are taken in the hepatoduodenal and gastrohepatic ligaments anchoring the duodenum upward. (Figs. 83 and 84.) Clamps are not applied to the severed ends of the ducts. Should the edges be uneven or frayed, they are trimmed evenly to permit accurate approximation of the duct as in blood vessel suturing. Both ends of the duct are held in position with retention sutures of silk. (Fig. 84.) A layer of interrupted sutures is placed without entering the lumen to approximate the outer walls. Upon completion of the posterior layer (S_1), the mucous membrane is closed with interrupted silk sutures (B, C and D), the knot being tied on the inside of the lumen in each instance. Following this the common duct is exposed for a distance, preferably downward, to permit the opening of the duct as in choledochostomy and the introduction of a small open-end catheter. This is passed up beyond the suture line to insure an adequate lumen for the duct at the time the anterior layer of sutures is placed. (Fig. 85.) If the duct has been divided quite low, this opening may be made in the hepatic duct above the suture line, and the catheter may be directed downward. The mucous membrane of the common duct is closed over the catheter with interrupted silk sutures (S_3), the knot on the inside. A

second suture layer (S_4) is placed close to the original to reinforce the line of anastomosis. All the sutures taken in the duct must be accurately placed with small needles and fine silk and must include

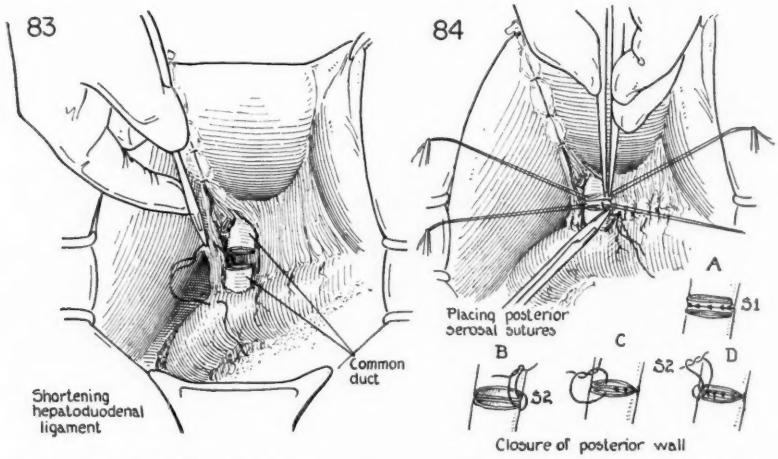


FIG. 83. The divided ends of the common duct are shown. The duodenum is drawn up toward the hilus of the liver by mattress sutures.

FIG. 84. The divided ends of the duct are held in approximation by traction sutures. The method of closure is schematically shown in A, B, C, and D.

only a minute bite of tissue to avoid stenosis. After the anastomosis has been completed, saline is injected into the catheter to make certain that there is no leakage about the suture line. (Fig. 86.) A final inspection is made to certify that there is no increased tension on the suture line. Should there be tension, additional anchoring sutures are taken in the adjacent ligamentous structure.

Strictures of the extrahepatic bile ducts may result from erosion of a calculus or prolonged inflammation, but the great majority are due to technical difficulties or surgical errors at the time of operation. The thoughtless surgeon, unable to control bleeding at the time of cholecystectomy, in desperation may clamp and ligate blindly with resultant inclusion of part or all of an extrahepatic bile duct. (Fig. 26.) Or he may fail to recognize the fact that the ampulla of the gall-bladder often lies parallel and adjacent to the common duct so that clamps applied roughly to the region of the ampulla in the early stages of cholecystectomy may also include a portion of the common duct, partially or completely dividing it. (Fig. 16.) Or since the cystic duct angulates the common duct sharply when the gall-bladder is retracted before the structures about the cystic duct are clearly defined, he may include the common

duct in his cystic duct ligation. (Fig. 21.) These technical mistakes the conscientious surgeon can overcome by following carefully each detail of the operative procedure and by resorting to chole-

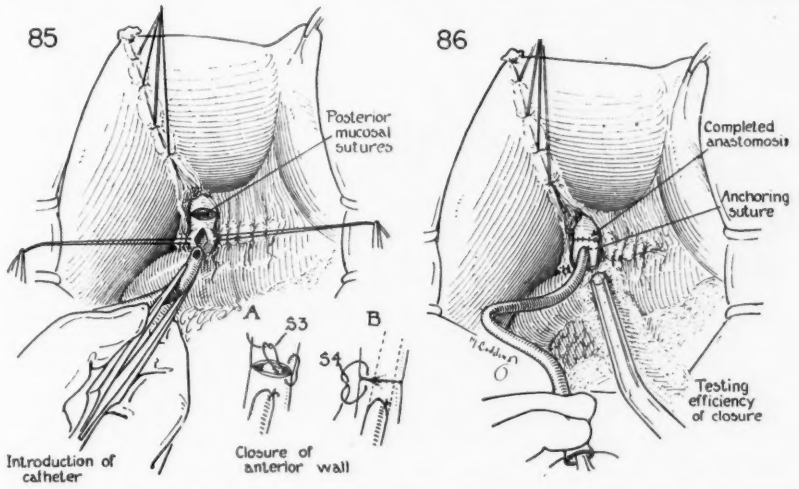


FIG. 85. An opening is made in the common duct below the point of anastomosis to permit the introduction of a catheter through the anastomosis. The method of closing the anterior wall of the common duct is shown in A and B.

FIG. 86. The security of the anastomosis is tested by the injection of saline.

cystostomy or removal of the gall-bladder from the fundus downward when the anatomy in the region of the cystic duct is distorted by extensive inflammation.

The symptoms of stricture depend on whether or not the duct was partially or completely ligated. If the duct was completely ligated, the patient may develop a severe and persistent jaundice immediately after operation. Stricture should also be considered in those patients developing profuse persistent biliary drainage during the postoperative period. Frequently the symptoms of stricture do not develop until months after operation. In such instances there has been a partial stenosis which remains asymptomatic until infection results from poor bile drainage. Then a painless jaundice of varying intensity, chills and fever, and all the signs of cholangitis may appear and recur intermittently. But since a common duct stone produces similar symptoms the surgeon must review the previous operative note. If there was difficulty with bleeding at the time of operation or technical difficulty in ligation of the cystic artery or cystic duct or profuse bile drainage, he should be suspicious of stricture.[16] Because these patients are usually jaundiced

the rigid preoperative preparation described under common duct stone for patients with jaundice is followed.

Heineke-Mikulicz Plastic. The most satisfactory method of handling a stricture cannot be determined until the involved area

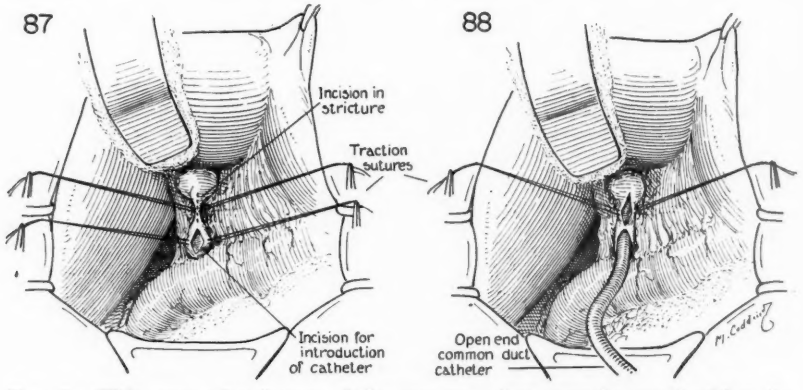


FIG. 87. This type of stricture of the common duct may be repaired by the principle of Heineke-Mikulicz.

FIG. 88. A small catheter is inserted beyond the point of the stricture.

has been thoroughly exposed. Occasionally a constricted area is found as the result of temporary application of clamps to the ducts. (Fig. 87.) In such instances the principle of Heineke-Mikulicz is used. Traction sutures are placed on either side of the isolated duct, and an opening is made either above or below the stricture depending upon the space available. An attempt is then made to pass a small probe or grooved director past the constriction. (Fig. 87.) With this metal director in place an incision is made throughout the constricted area. Traction sutures are placed in the cut edges of the ducts because it is necessary to sew up this opening in the opposite direction. An open-end catheter is passed through the previously made opening in the duct below the point of stricture, is directed beyond the constricted area, and is anchored in position with an interrupted silk suture. (Figs. 88 and 89.)

Before suturing the duct the duodenum must be thoroughly mobilized, so that there will be absolutely no tension on the suture line at the completion of the closure, in other words the distance gained must be more than the length of the vertical incision in the common duct. Frequently, however, because of a previous cholecystectomy, the duodenum is drawn up toward the hilus of the liver and mobilization of the duodenum is unnecessary. If it has been necessary to mobilize the duodenum, it is pulled upward and

anchored with interrupted silk mattress sutures which include a bit of the hepatoduodenal and gastrohepatic ligaments. After the duodenum has been freed and anchored in the desired position,

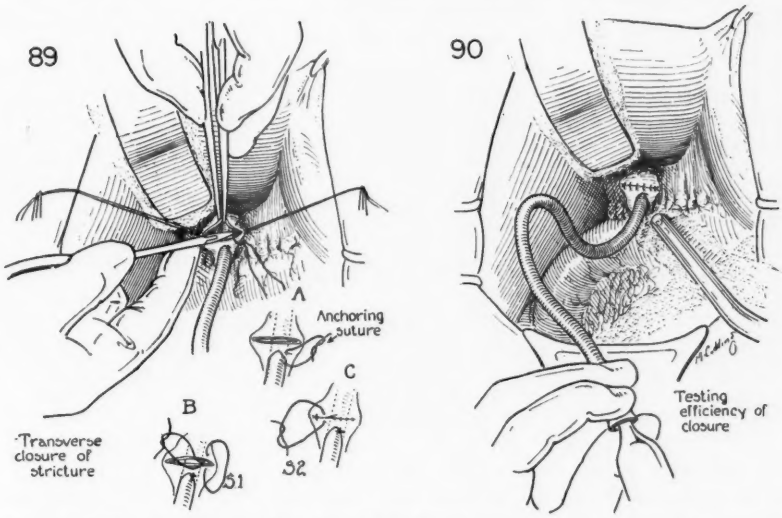


FIG. 89. The duodenum has been anchored upward to insure absence of tension on the suture line. The method of closure is illustrated in A, B, and C.

FIG. 90. The point of stricture is now the wide point of the common duct. Saline is injected to test the efficiency of the closure.

the opening in the duct at the point of stricture is approximated in the opposite direction with a fine silk suture.

The traction sutures are gently manipulated until the upper and lower lips of the opening approximate. (Fig. 89.) Interrupted silk sutures are taken including just the margin of the cut duct and are tied with the knot on the inside (s_1). A reinforcing layer of interrupted silk sutures (s_2) is then placed. The security of the suture line is finally tested by injecting saline through the catheter. (Fig. 90.) A final inspection is also made to insure that there is no tension on the suture line. The area is then covered with omentum, and a cigarette drain is inserted down to the anastomosis. A routine closure follows.

Anastomosis, Duct to Duodenum (with and without Tube). The surgeon is frequently faced with the difficult problem of finding the strictured area or ligated end of the common duct. When this is the case, he should not hesitate to follow his dissection high up into the hilus of the liver. The upper portion of the duct may be located by aspiration for bile with a fine hypodermic needle. Once its approxi-

mate location is determined, the dissection is carried well up into the hilus because it is better to attempt to isolate a small segment of duct and anastomose it directly to the duodenum than to institute tube

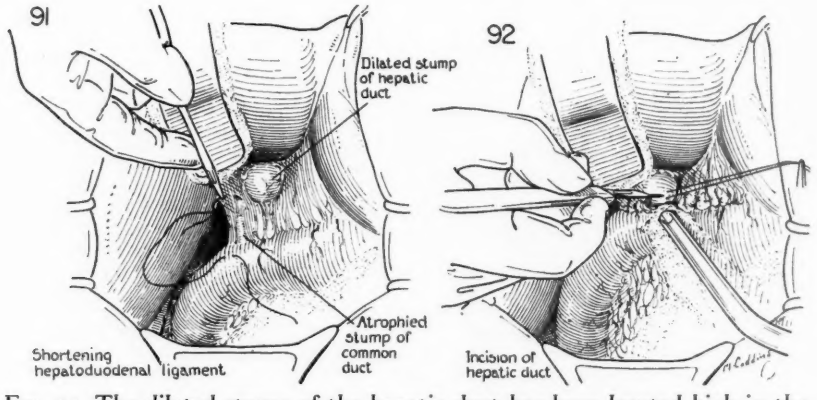


FIG. 91. The dilated stump of the hepatic duct has been located high in the hilus. The duodenum has been mobilized and is about to be anchored upward to permit a direct hepatoduodenal anastomosis.

FIG. 92. The dilated hepatic duct is held in position with traction sutures, and a small incision made into it in preparation for an anastomosis.

drainage and depend upon the formation of an external fistula which will have to be implanted subsequently. After the dissection has been carried well up toward the hilus of the liver and the dilated stump of duct is found, it is further isolated by sharp and blunt dissection. (Fig. 91.) Traction sutures of fine silk are taken in opposite sides of the duct, and with a small, sharp knife, an incision is made directly into the bulbous structure. (Fig. 92.) The initial incision should be small for it can be lengthened later or the anterior lip can be divided in a direction at right angles to the original incision as desired. This is done after the duodenum has been thoroughly anchored with mattress sutures up to a point where the anastomosis can be carried out without any tension on the suture line. (Fig. 92.) With the lumen of the duct held open by traction sutures of fine silk, the duct is anchored with interrupted silk sutures to the anterior duodenal wall at its superior margin. (Fig. 93.) These sutures (S_1) used in the anastomosis should not enter the lumen of the duodenum or the duct; any which do are replaced. It is usually necessary to take about four or five sutures for the posterior layer. A small incision is made directly into the duodenum close to the serosal sutures previously placed. (Fig. 94.) The field is well walled off during this time and constant suction is maintained adjacent

to the duodenal incision to prevent soiling from the escaped bile or duodenal juices. The mucous membrane is then closed using interrupted sutures (S_2 and S_3) with the knot always on the inside. A

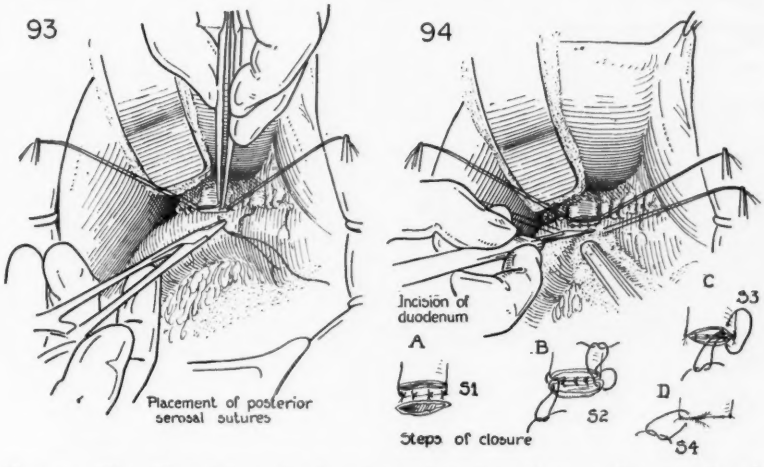


FIG. 93. The dilated hepatic duct is anchored to the superior margin of the duodenum.

FIG. 94. Interrupted sutures of fine silk are used to effect a two layer closure. The method of anastomosis is demonstrated in A, B, C and D.

reinforcing row of interrupted silk sutures (S_4) is placed close to the initial suture line to avoid turning in more tissue than necessary.

As an alternate method some surgeons prefer to use a rubber tube which, they believe, facilitates the anastomosis and prevents undue stenosis of the suture line. (Fig. 95.) A small rubber tube about 5 mm. in diameter, depending upon the size of the ducts, and about 6 to 8 cm. long is inserted for a short distance upward into the common duct and down into the duodenum after the two posterior layers of the anastomosis are completed. This is anchored to the duct with a fine silk suture which is tied very tight so that it will slough through in a few days. (Fig. 96.) The anterior wall is closed with two layers of interrupted silk sutures as shown in Fig. 94. If upon inspection there is tension on the suture line, the duodenum is further freed and reanchored with mattress sutures on each side of the site of anastomosis. (Fig. 97.)

Only the simpler types of anastomosis have been incorporated in this discussion. The direct anastomosis of the stump of the duct to the duodenum is probably the most satisfactory site of reanastomosis of the severed biliary tree to the gastrointestinal tract. But various other types have been recommended, and the surgeon operating

upon the patient with stricture should be familiar with all in order to select the one best suited for overcoming the technical difficulties encountered.

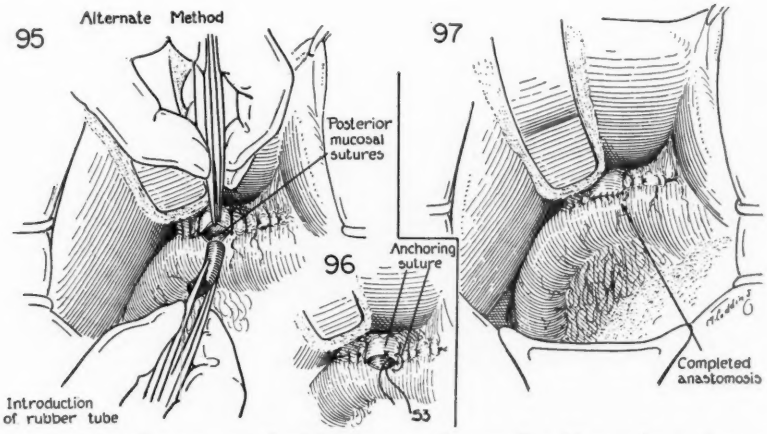


FIG. 95. An alternate method is the use of a small rubber tube to insure the patency of the anastomosis.

FIG. 96. The tube is anchored in place with a fine silk suture.

FIG. 97. The anastomosis has been completed and the duodenum has been fixed well up toward the hilus of the liver to avoid tension on the line of anastomosis.

CARCINOMA INVOLVING THE GALL-BLADDER AND EXTRAHEPATIC DUCTS

Within the past five years in the Peter Bent Brigham Hospital there were six cases of primary carcinoma of the gall-bladder, five of the ducts, and five of the head of the pancreas. In addition there was an occasional case in which metastatic glands from neoplasms of the stomach, breast, or sigmoid produced an obstructive jaundice due to extrinsic pressure on the extrahepatic bile ducts.

Carcinoma of the gall-bladder usually presents symptoms similar to those of chronic cholecystitis and cholelithiasis because of the high incidence of gallstones. Stones were recovered in 50 per cent of our cases and may have been present in others in which the neoplasm was so extensive that the gall-bladder was not opened. Stones, some suggest, are the causative factor of carcinoma of the gall-bladder due to the chronic irritation their presence creates. There is a common association with jaundice because of the presence of large metastatic glands in the portal fissures and possible involvement of the extrahepatic ducts by direct extension. Unlike chronic cholecystitis and cholelithiasis, however, the symptoms of carcinoma are progressive, with no tendency toward remission. Occasionally

the neoplasm may be so large that it produces a hard tender mass in the right upper quadrant. Usually, however, the diagnosis is not made before operation unless the mass is large and the patient has a concomitant history suggestive of malignant disease, such as weight loss, cachexia, etc. Although carcinoma of the gall-bladder occurs most frequently in the elderly (average 60 years), a very early carcinoma of the gall-bladder was found in a man 34 years of age having a cholecystectomy primarily for cholelithiasis. This suggests that early cholecystectomy should be recommended whenever the presence of gallstones is proved. In the majority of instances the extent of the neoplasm was so great that no more than biopsy of the lesion was attempted. Patients may show temporary response to *x*-ray treatment, but no curative effects will result.

Carcinoma of the bile ducts occurs usually in patients somewhat older (67 years) than those with carcinoma of the gall-bladder or of the head of the pancreas, and produces early intense jaundice due to complete obstruction of the common duct. It may or may not be accompanied by a past history of biliary tract disease. Diagnosis of carcinoma of the bile ducts cannot be made previous to operation. If the lesion occurs below the junction of the cystic and hepatic ducts, the gall-bladder may be enlarged and so may be used for a short circuiting operation to relieve the patient of the symptoms due to intense jaundice. During the past five years carcinoma of the bile duct was resected in one patient who did not recover.

Although our statistics show only five cases of carcinoma of the head of the pancreas during the last five years, this lesion occurs usually more often than carcinoma of the gall-bladder or the bile ducts. Along with common duct stone it comprises one of the two most common causes of obstructive jaundice. It is our belief that the physician can usually differentiate from the history and physical findings between jaundice-producing neoplasm and common duct stone with a fair degree of accuracy. In contrast to the symptoms of common duct stone described earlier, patients having neoplasm of the head of the pancreas rarely give a past history of gall-bladder disease or colic, though the majority have distress or pain of varying severity, usually in the epigastrium, right upper quadrant, or back. Weight loss is a primary diagnostic finding and occurs in almost 90 per cent of our patients, the average being 7 pounds per month. The presence of jaundice as such is not of particular diagnostic value unless it is continuous and increasing in severity. The sex ratio is

often of importance and may influence the physician making a diagnosis because of the high incidence of common duct stones in women and of neoplasm of the pancreas in men. As in neoplasms elsewhere, the patient with carcinoma of the head of the pancreas will give a history of increasing severity of all symptoms. The physical findings also may be of distinct value in making a diagnosis. A large, palpable gall-bladder in the presence of jaundice is presumptive evidence of neoplasm and was found in 55 per cent of our patients with carcinoma of the head of the pancreas. Enlargement of the liver is frequent in the presence of pancreatic neoplasm. However, an irregular hard mass was palpated in the epigastrium in only 9 per cent of our patients with carcinoma of the head of the pancreas.

Involvement of the gall-bladder and extrahepatic bile ducts with carcinoma offers little opportunity of early diagnosis or radical extirpation, but a patient may be offered palliative surgery with the relief of the obstructive jaundice. When the diagnosis of obstructive jaundice due to tumor is made, regardless of whether it is primary in the head of the pancreas or due to extrinsic pressure from metastatic glands, the physician should recommend surgical exploration. This attitude cannot be too strongly advocated because, regardless of how hopeless the situation may appear and how definite the diagnosis of malignancy may be, frequently the surgeon may find a calculus instead of neoplasm as the source of disease. Furthermore, in the cases of neoplasm a palliative surgical procedure may be carried out which will relieve the patient of the disagreeable symptoms associated with intense icterus. Occasionally a very small neoplasm, involving the head of the pancreas only, is found which may be resected successfully, as has been demonstrated by Whipple and his associates. The physician, therefore, must not take a hopeless attitude toward the surgical treatment of such patients. In our opinion, all should be offered the possible benefit of surgical exploration.

Since these patients are usually markedly jaundiced, attention must be directed toward combating a bleeding tendency as described under the treatment of jaundice. In addition at the time of operation it is advisable to have at least two blood donors available.

In view of the fact that these patients are generally in poor condition we prefer to carry out any operative procedure under local infiltration anesthesia (1 per cent novocaine without adrenalin).

Cholecystogastrostomy (Direct and Valvular Types). The abdomen is opened through a right rectus incision which is usually not carried as high over the xiphoid as is customary in cholecystectomy.

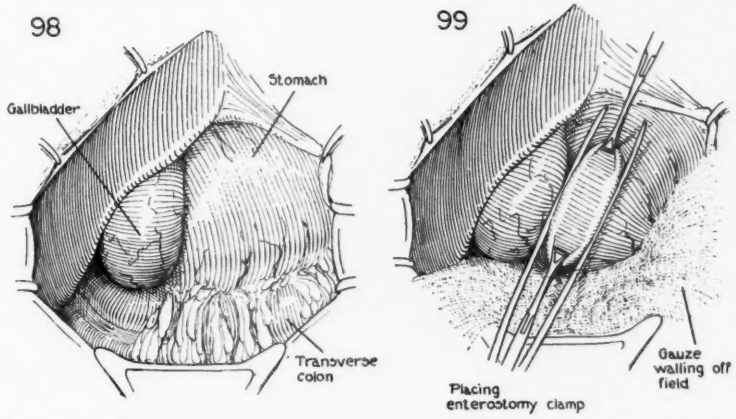


FIG. 98. The proximity of the elongated, dilated gall-bladder to the stomach and duodenum is illustrated.

FIG. 99. The anterior gastric wall adjacent to the gall-bladder is fixed with an enterostomy clamp in preparation for the anastomosis.

Every bleeding point, no matter how small, is tied to avoid if possible the danger of internal hemorrhage. The abdomen is thoroughly explored for evidence of metastasis, and the local cause of the distended gall-bladder is determined. The duct system is likewise inspected to rule out involvement by carcinoma, or extrinsic pressure from metastatic glands as is usually the case in carcinoma in the region of the head of the pancreas. It is also advisable to inspect and palpate the stomach for evidence of neoplastic involvement. What appears to be carcinoma from a malignant obstruction will occasionally prove to be a calculus. Even more trying are those cases in which there is no evidence of a mass that can be palpated. This is especially true in the very small tumors involving the lower end of the duct and the region of the papilla of Vater. If the gall-bladder is thin-walled and distended and offers no evidence of calculi, and if no calculi are palpable in the common duct, it is inadvisable to open the common duct. Since these patients are usually poor risks, it is better to decompress the biliary tree rather than attempt a more accurate diagnosis in the region of the ampulla by transduodenal approach. It has been our custom to anastomose the gall-bladder to either the stomach or the duodenum depending upon the

proximity of the fundus of the gall-bladder to these structures. If the lesion is small and the general condition of the patient permits, the problem arises of whether or not the original operation should be planned to permit resection of the head of the pancreas later.[24]

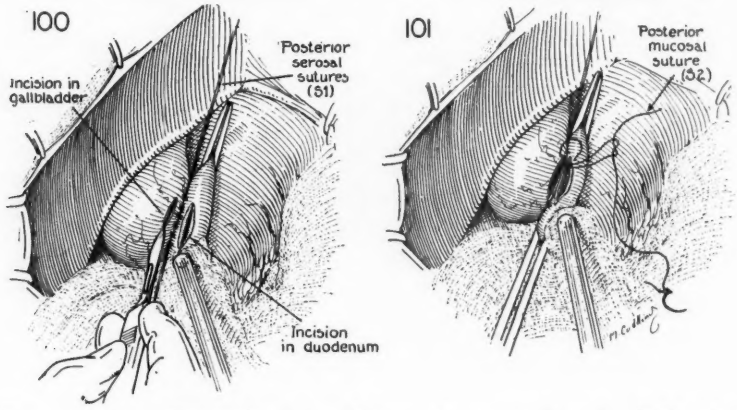


FIG. 100. A small opening is made into the stomach and gall-bladder adjacent to the suture line after the posterior layer of interrupted sutures is completed.

FIG. 101. After ligating any vessels of size the mucous membrane is closed with interrupted sutures of fine silk.

We have usually preferred to use the stomach for anastomosis because of its proximity to the enlarged gall-bladder (Fig. 98) although some prefer the small intestine[17] because it is more accessible and its wall approximates in thickness that of the gall-bladder. The anterior gastric wall near the region of the pylorus is grasped with Allis clamps between the lesser and greater curvature, and a straight enterostomy clamp without rubber covers is applied at the site of anastomosis. (Fig. 99.) This fixes the gastric wall to permit more accurate anastomosis of the fundus of the gall-bladder, to control bleeding, and to avoid contamination. The field is thoroughly walled off with gauze sponges. That portion of the gall-bladder which lends easiest approximation to the stomach is used in the anastomosis. Once the site is selected, a layer of interrupted sutures is taken to include the serosa of the gall-bladder and stomach for a distance of about 2.5 cm., the angle sutures being left long for traction. (Fig. 100.) Since the gall-bladder wall is very thin, great care must be exercised in placing the sutures that the wall is not torn. These sutures may be placed before the gall-bladder is aspirated, or if preferred, an opening may be made in the fundus of the gall-bladder with a large needle and the contents aspirated. Following this, an incision to permit a stoma about the size of the adult little finger is

made both in the stomach and in the gall-bladder. (Fig. 100.) The contents of the gall-bladder are aspirated with suction, every effort being made to avoid bile contamination within the peritoneal cavity.

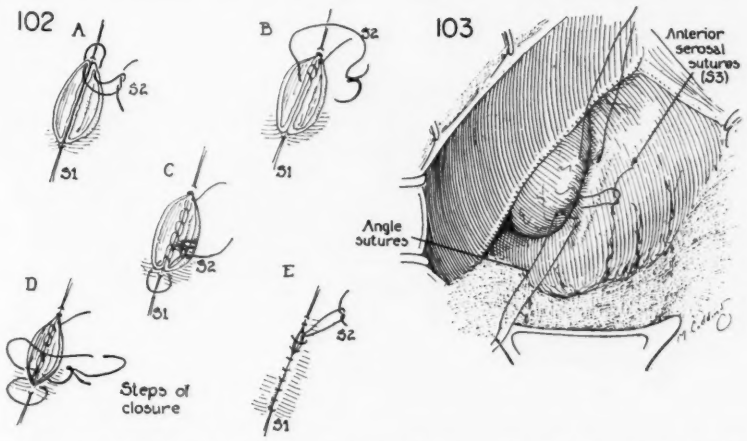


FIG. 102. Details of the anastomosis are schematically illustrated in the sketches A to E.

FIG. 103. Additional interrupted mattress sutures of silk are taken to insure the absence of tension at either angle of the anastomosis.

Although there are very few vessels in the fundus of the gall-bladder, sizable vessels, especially in the jaundiced patient, should be individually ligated. This applies to vessels in the gastric wall as well. The mucosa is then closed with a continuous silk suture, each stitch being placed close to the preceding one, since one of the functions of this suture is to avert hemorrhage. (Figs. 101 and 102A, B, and C.) The ordinary Connell type of stitch is used for the anterior surface. (Fig. 102D and E.) Following the completion of the mucosal suture, a second anterior layer of interrupted sutures is placed between the gall-bladder and stomach. (Fig. 103.) It is advisable to reanchor the stomach to the gall-bladder with several interrupted sutures (S_3) beyond the angles. In addition it is occasionally advisable to anchor the stomach to the region of the round ligament to remove tension on the anastomosis. Whether or not a gastroenterostomy is done will depend somewhat on the size of the lesion and on whether the surgeon plans to attempt a resection of the head of the pancreas later.

Recently we have used a valvular type of cholecystogastrostomy instead of the direct anastomosis previously described. Although the direct type of anastomosis has been moderately effective as a palliative procedure, it has been found by Whipple to result in cholangitis and hepatitis. For this reason various types of anastomoses have

been proposed in an effort to avoid ascending biliary infection. It is surprising that, in the absence of function of the valve-like mechanism of the sphincter of Oddi, a higher incidence of cholangitis and

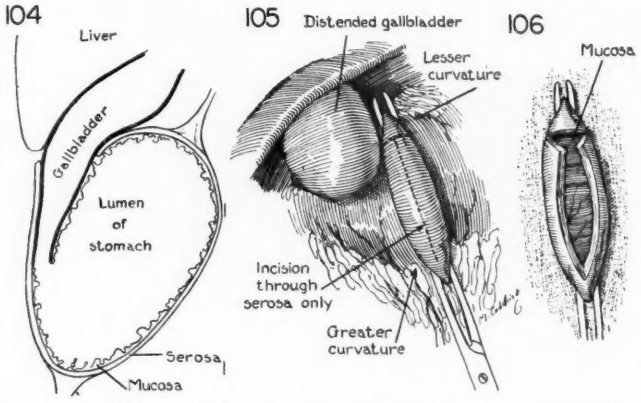


FIG. 104. Schematic drawing to illustrate how the valve-like effect is obtained by implanting the gall-bladder obliquely within the wall of the stomach.*

FIG. 105. A T-shaped incision is made through the seromuscular coat from lesser to greater curvature of the stomach in the region of the pylorus.

FIG. 106. The transverse incision near the greater curvature is made large enough to avoid constriction of the gall-bladder after implantation.

evidence of infection do not result when the biliary tree is anastomosed to the gastrointestinal tract. The lack of the valve-control permits an interchange of contents between the gall-bladder and the gastrointestinal tract which encourages mild infection that does not ordinarily produce clinical symptoms but yet may be of a very serious nature.

In an effort to avoid at least gross interchange between the contents of the gastrointestinal tract and the biliary passages, we have devised a valvular type of cholecystogastrostomy following a technique developed by animal experimentation. It was found that the gallbladder could be implanted for a distance between the seromuscular coat and the mucous membrane of the stomach and retain its viability, giving valve-like protection and preventing the contents of the stomach from entering the gall-bladder. Experimentally there was less dilatation of the biliary system following the valvular type of anastomosis than following the direct type.[28] Furthermore it was found that if the fundus of the gall-bladder was

* Figs. 104–114 inclusive are reproduced by the courtesy of *Surgery, Gynecology & Obstetrics.*

pulled into the lumen of the stomach, stenosis might result, and that a direct anastomosis must be made between the fundus of the gall-bladder and the mucous membrane of the stomach. We believe that

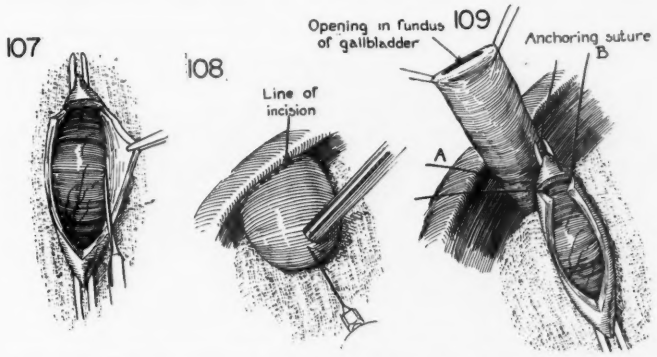


FIG. 107. The seromuscular flaps are developed on either side to give sufficient space for implantation of the gall-bladder.

FIG. 108. If the gall-bladder is not elongated sufficiently to permit implantation, an incision is made into the serosa to permit its possible detachment from the liver bed.

FIG. 109. The lesser curvature of the stomach is anchored deep to the under surface of the gall-bladder with interrupted silk sutures.

the valvular type of cholecystogastrostomy instead of a complicated type of anastomosis with the small intestine may be beneficially used. Since the gall-bladder in the presence of obstructive jaundice is usually dilated, it is sufficiently elongated to permit implantation in the gastric wall for at least 2.5 to 3 cm. (Fig. 104.) It may be safely detached from the liver bed without interference with its blood supply. That detachment of the region of the fundus of the gall-bladder is a safe and satisfactory procedure has been verified by us, both experimentally and clinically.

A portion of the anterior gastric wall which lies in close proximity to the gall-bladder is grasped near the greater curvature with Allis clamps, and a straight enterostomy clamp without rubber covers is applied to fix the gastric wall, control bleeding, and avoid contamination when the mucous membrane of the stomach wall is divided. (Fig. 105.) A T type incision is made to avoid constriction of the gall-bladder as it enters the gastric wall. This transverse incision should be 2 cm. long. (Fig. 106.) It is usually necessary to ligate a few vessels coming from the lesser curvature in this location. The seromuscular flaps are then dissected by sharp and blunt dissection from the underlying mucosa until easy implantation of the gall-bladder is permissible. (Fig. 107.)

The gall-bladder is now prepared for anastomosis. The contents are aspirated with a syringe or trocar through the fundus, at a point which has been selected for the anastomosis. (Fig. 108.) If the gall-

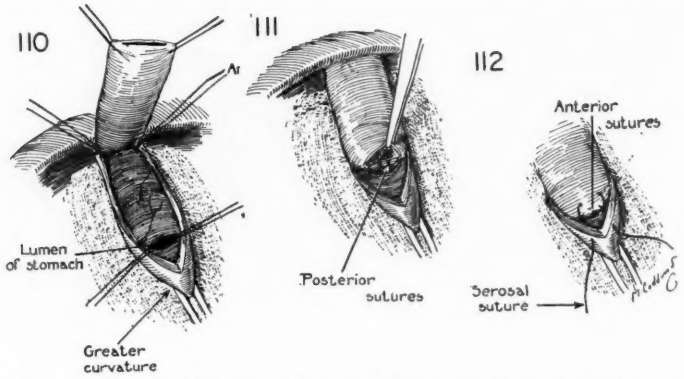


FIG. 110. An opening is made into the lumen of the stomach near the greater curvature. Traction sutures are placed in the opening of both the stomach and gall-bladder to facilitate the anastomosis.

FIG. 111. A direct anastomosis is made with interrupted sutures of silk between the fundus of the gall-bladder and the mucous membrane of the stomach.

FIG. 112. The fundus of the gall-bladder is anchored toward the greater curvature. The enterostomy clamp is removed.

bladder is not sufficiently elongated beyond the liver margin, an incision is made in the serosa, and it is detached for 3 or 4 cms. from the liver bed. The opening in the fundus of the gall-bladder is then increased to admit the tip of the adult finger. Traction sutures of fine silk are applied to either angle of the opening in preparation for the anastomosis. At this stage it is usually advisable to anchor the under surface of the gall-bladder as low as possible on the serosa near the lesser curvature because if this is delayed until the anastomosis is completed, exposure is very difficult. These sutures are usually taken deeper than those shown in Figure 109. After the lesser curvature is anchored to the under surface of the gall-bladder with interrupted silk sutures, an opening is made in the mucous membrane of the stomach near the greater curvature and its margins are held apart with traction sutures of fine silk. (Fig. 110.) A direct anastomosis is then made between the fundus of the gall-bladder and the mucous membrane of the stomach with one layer of interrupted silk sutures. Experimentally when the lumen of the gall-bladder was drawn within the lumen of the stomach, stenosis resulted. The same result followed in those patients on whom a similar technique was followed, making it evident that a direct anastomosis must be made to avoid stenosis.

(Fig. 111.) After the direct anastomosis is made and the patency of the lumen is verified by palpation the seromuscular flap is approximated in one layer with interrupted silk sutures which include a

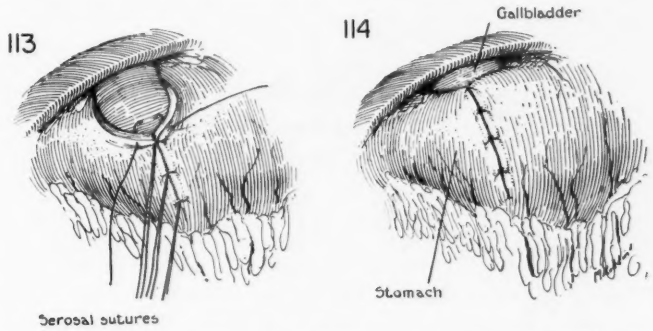


FIG. 113. The seromuscular flaps are approximated with interrupted sutures of silk which include a small bite of the gall-bladder wall.

FIG. 114. The gastric wall is closed toward the lesser curvature but not high enough to constrict the blood supply of the gall-bladder. It is not desirable to use a second layer of interrupted silk sutures in the seromuscular flaps.

small bite of the underlying gall-bladder wall. (Fig. 112.) These interrupted sutures are continued up toward the lesser curvature. (Fig. 113.) The flaps should not constrict the gall-bladder at the point of entry into the gastric wall near the lesser curvature. Undue constriction of the gall-bladder at this point is avoided to a large extent by making the cross incision sufficiently long. (Fig. 106.) Additional sutures may be taken between the gall-bladder and the anterior gastric wall if preferred. (Fig. 114.) The omentum is brought up to the site of anastomosis, and routine closure follows. As in any case of abdominal incision in the presence of malignancy and malnutrition, retention sutures in sufficient number should be included in the closure.

Because these patients are usually severely jaundiced the immediate postoperative concern is the control of the hemorrhagic tendency. Vitamin K therapy and transfusions are indicated. The diet should be limited for about one week to avoid undue tension on the suture line.

Although there was a hospital mortality of 25 per cent following some type of short circuiting operation in the presence of obstructive jaundice, the majority of the survivors experienced relief from pruritus, pain, and jaundice by the time they left the hospital and lived in relative comfort for an average of nine months.

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